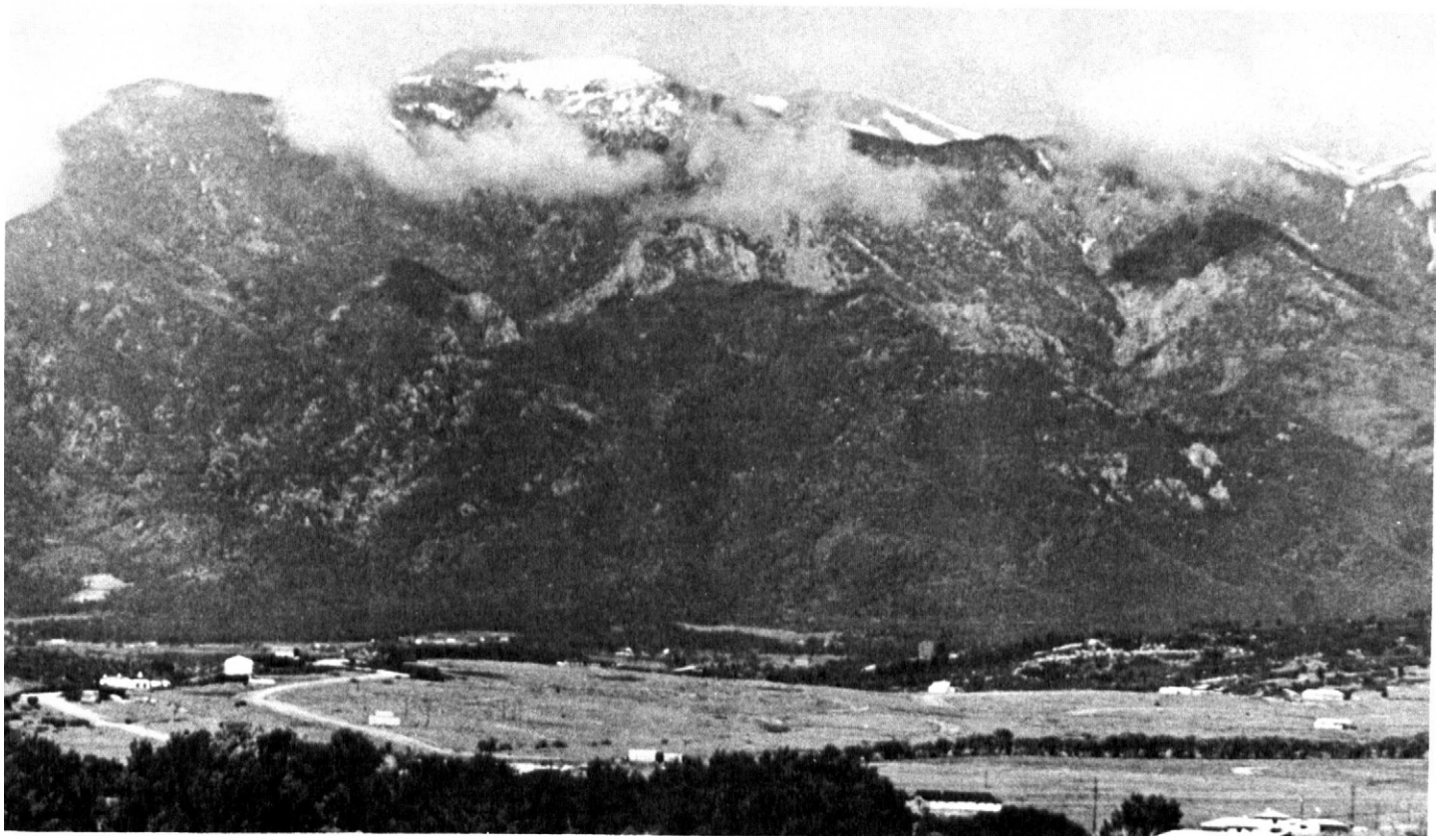
SOIL SURVEY OF

Pueblo Area, Colorado

Parts of Pueblo and Custer Counties



United States Department of Agriculture
Soil Conservation Service
in cooperation with
Colorado Agricultural Experiment Station

This is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and agencies of the States, usually the Agricultural Experiment Stations. In some surveys, other Federal and local agencies also contribute. The Soil Conservation Service has leadership for the Federal part of the National Cooperative Soil Survey. In line with Department of Agriculture policies, benefits of this program are available to all who need the information, regardless of race, color, national origin, sex, religion, marital status, or age.

Major fieldwork for this soil survey was completed in the period 1968-73. Soil names and descriptions were approved in 1974. Unless otherwise indicated, statements in the publication refer to conditions in the county in 1973. This survey was made cooperatively by the Soil Conservation Service and the Colorado Agricultural Experiment Station. It is part of the technical assistance furnished to the South Pueblo County, Turkey Creek, Central Colorado, Custer County Divide, Olney-Boone, and West Otero Conservation Districts.

Soil maps in this survey may be copied without permission, but any enlargement of these maps could cause misunderstanding of the detail of mapping and result in erroneous interpretations. Enlarged maps do not show small areas of contrasting soils that could have been shown at a larger mapping scale.

HOW TO USE THIS SOIL SURVEY

THIS SOIL SURVEY contains information that can be applied in managing farms and ranches; in selecting sites for roads, ponds, buildings, and other structures; and in judging the suitability of tracts of land for farming, industry, and recreation.

Locating Soils

All the soils of the Pueblo Area are shown on the detailed map at the back of this publication. This map consists of many sheets made from aerial photographs. Each sheet is numbered to correspond with a number on the Index to Map Sheets.

On each sheet of the detailed map, soil areas are outlined and are identified by symbols. All areas marked with the same symbol are the same kind of soil. The soil symbol is inside the area if there is enough room; otherwise, it is outside and a pointer shows where the symbol belongs.

Finding and Using Information

The "Guide to Mapping Units" can be used to find information. This guide lists all the soils of the survey area in alphabetic order by map symbol and shows the capability classification of each. It also shows the page where each soil is described and the page for the range site to which the soil has been assigned.

Individual colored maps that show the relative suitability or degree of limitation of soils for many specific purposes can be developed by using the soil map and the information in the text. Translucent material can be used as an overlay over the soil map and colored to show soils that have the limitation or suitability. For example, soils that have a slight limitation for a given use can be colored green, those that have a moderate limitation can be colored yellow, and those that have a severe limitation can be colored red.

Farmers and those who work with farmers can learn about use and management of the soils from the soil descriptions and from the descriptions of the range sites.

Foresters and others can refer to the section "Woodland."

Wildlife managers and others can find information about soils and wildlife in the section "Wildlife."

Ranchers and others can find, under "Range," groupings of the soils according to their suitability for range and, also, the names of many of the plants that grow on each range site.

Community planners and others can read about soil properties that affect the choice of sites for nonindustrial buildings and for recreation areas in the sections "Land Use Planning" and "Recreation."

Engineers and builders can find, under "Engineering Uses of the Soils," tables that contain estimates of soil properties and information about soil features that affect engineering practices.

Scientists and others can read about the soils in the section "Formation and Classification of the Soils."

Newcomers in the survey area may be especially interested in the section "General Soil Map," where broad patterns of soils are described. They may also be interested in the information about the survey area given in the section "General Nature of the Area."

Cover: Soils of the Nunn-Stroupe-Holderness association are in the foreground, and those of the Wetmore-Larkson-Pinata association are on the foothills and on the mountain side slopes.

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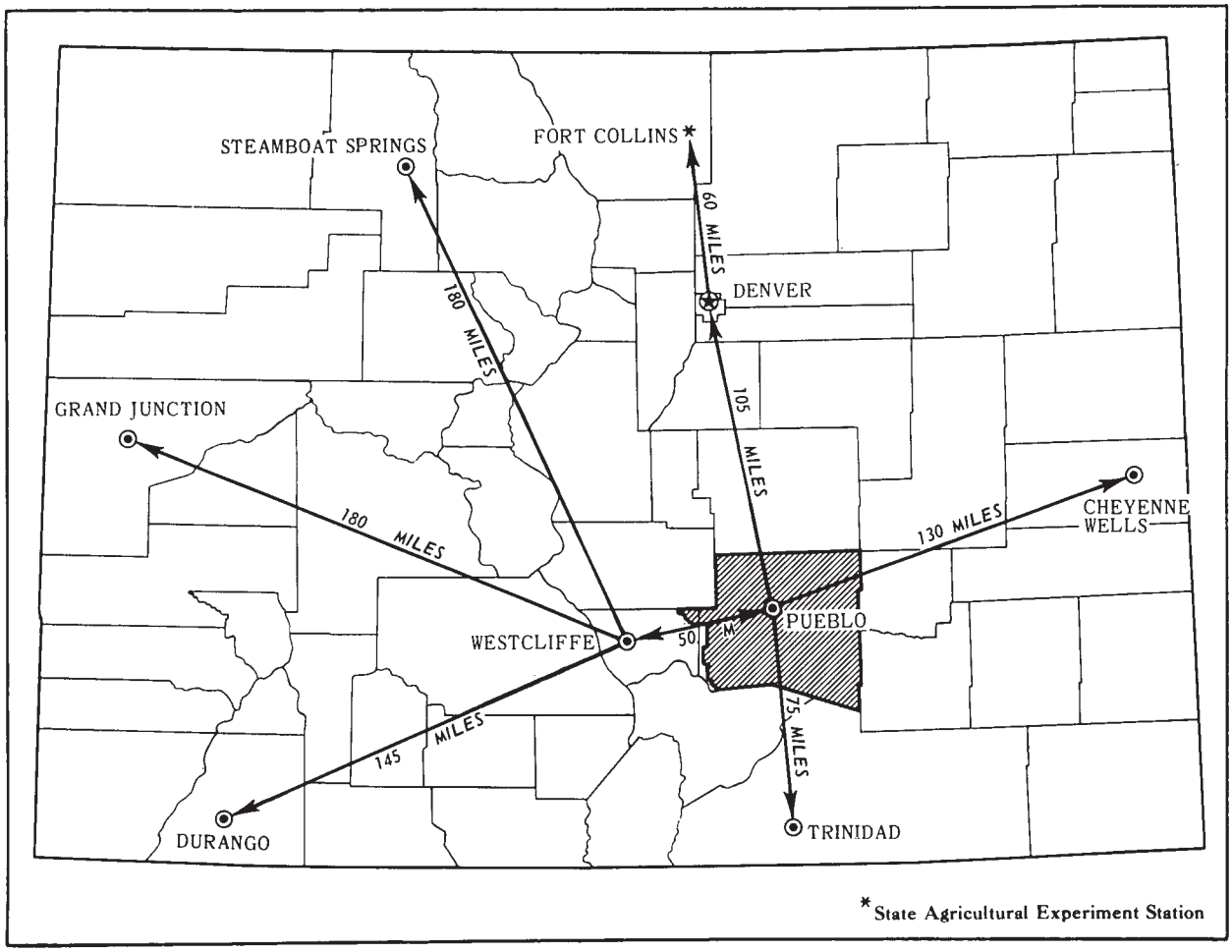

Location of Pueblo Area in Colorado.

SOIL SURVEY OF PUEBLO AREA, COLORADO
PARTS OF PUEBLO AND CUSTER COUNTIES

By Roy J. Larsen, Thomas J. Wiggins, Dale L. Holden, M. Bruce McCulloch, and Rodney E. Preator, Soil Conservation Service

United States Department of Agriculture, Soil Conservation Service, in cooperation with the Colorado Agricultural Experiment Station

PUEBLO AREA, COLORADO, Parts of Pueblo and Custer Counties, is in the south-central part of the state. It has a land area of 1,527,070 acres. The maximum dimensions are 54 miles from north to south and 60 miles from east to west. The survey area includes 11,840 acres in the northeast corner of Custer County, which is bordered by Pueblo County on the east and national forest land on the west. This part of Custer County is included in the survey area because the soils there are more similar to those in the western part of Pueblo County than to the soils in the rest of Custer County. Also, it is separated from the rest of Custer County by a large area of national forest land.

About 1,099,490 acres of the survey area is used for range; 37,570 acres is used for irrigated crops, pasture, and hay; 94,280 acres is used for dryland crops; and 104,750 acres is forest land, of which 18,600 acres is used for commercial forest. The rest of the acreage is in cities and towns, a military reservation, and waterways or water storage areas. The part of the San Isabel National Forest that is in Pueblo County was not included in the survey area.

The city of Pueblo is the county seat of Pueblo County. Westcliffe is the county seat of Custer County.

How This Survey Was Made

Soil scientists made this survey to learn what kinds of soil are in the Pueblo Area, where they are located, and how they can be used. The soil scientists went into the survey area knowing they likely would find many soils they had already seen and perhaps some they had not. They observed the steepness, length, and shape of slopes; the size and speed of streams; the kinds of native plants or crops; the kinds of rock; and many facts about the soils. They dug many holes to expose soil profiles. A profile is the sequence of natural layers, or horizons, in a soil; it extends from the surface down into the parent material that has not been changed much by leaching or by the action of plant roots.

The soil scientists made comparisons among the profiles they studied, and they compared these profiles with those in counties nearby and in places more distant. They classified and named the soils according to nationwide, uniform procedures. The *soil series* and the *soil phase* are the categories of soil classification most used in a local survey.

Soils that have profiles almost alike make up a soil series. Except for different texture in the surface layer, all the soils of one series have major horizons that are similar in thickness, arrangement, and other important characteristics. Each soil series is named for a town or other geographic feature near the place where a soil of that series was first observed and mapped. Penrose and Minnequa, for example, are the names of two soil series. All the soils in the United States that have the same series name are essentially alike in those characteristics that affect their behavior in the undisturbed landscape.

Soils of one series can differ in texture of the surface layer and in slope, stoniness, or some other characteristic that affects use of the soils by man. On the basis of such differences, a soil series is divided into phases. The name of a soil phase indicates a feature that affects management. For example, Olney sandy loam is one of two phases within the Olney series.

After a guide for classifying and naming the soils had been worked out, the soil scientists drew the boundaries of the individual soils on aerial photographs. These photographs show woodlands, buildings, field borders, trees, and other details that help in drawing boundaries accurately. The soil map at the back of this publication was prepared from aerial photographs.

The areas shown on a soil map are called mapping units. On most maps detailed enough to be useful in planning the management of farms and fields, a mapping unit is nearly equivalent to a soil phase. It is not exactly equivalent, because it is not practical to show on such a map all the small, scattered bits of soil of some other kind that have been seen within an area that is dominantly of a recognized soil phase.

Some mapping units are made up of soils of different series or of different phases within one series. Two such kinds of mapping units are shown on the soil map of the Pueblo Area: soil complexes and soil associations.

A soil complex consists of areas of two or more soils, so intermingled or so small in size that they cannot be shown separately on the soil map. Each area of a complex contains some of each of the two or more dominant soils, and the pattern and relative proportions are about the same in all areas. The name of a

soil complex consists of the names of the dominant soils, joined by a hyphen. Glenberg-Haverson fine sandy loams is an example.

A soil association is made up of adjacent soils that occur as areas large enough to be shown individually on the soil map but are shown as one unit because the time and effort of delineating them separately cannot be justified. There is a considerable degree of uniformity in pattern and relative extent of the dominant soils, but the soils may differ greatly one from another. The name of an association consists of the names of the dominant soils, joined by a hyphen. Arvada-Keyner association is an example.

In most areas surveyed there are places where the soil material is so rocky, so shallow, or so severely eroded that it cannot be classified by soil series. These places are shown on the soil map and are described in the survey, but they are called land types and are given descriptive names. Eutroboralfs, steep, is a land type in this survey area.

While a soil survey is in progress, samples of soils are taken, as needed, for laboratory measurements and for engineering tests. Data about yields of crops under defined practices are assembled from farm records and from field or plot experiments on the same kinds of soil. Yields under defined management are estimated for all the soils.

But only part of a soil survey is done when the soils have been named, described, and delineated on the map and the laboratory data and yield data have been assembled. The mass of detailed information then needs to be organized in such a way as to be readily useful to different groups of users, among them farmers, managers of woodland and range, and engineers.

On the basis of yield and practice tables and other data, the soil scientists set up trial groups. They test these groups by further study and by consultation with farmers, agronomists, engineers, and others. Then they adjust the groups according to the results of their studies and consultation. Thus, the groups that are finally evolved reflect up-to-date knowledge of the soils and their behavior under present methods of use and management.

General Soil Map

The general soil map at the back of this survey shows, in color, the soil associations in the survey area. A soil association is a landscape that has a distinctive pattern of soils in defined proportions. It typically consists of one or more major soils and at least one minor soil, and it is named for the major soils. The soils in an association can occur in other associations, but in different patterns.

A map that shows soil associations is useful to people who want to have a general idea of the soils in a survey area, who want to compare different parts of that area, or who want to find suitable sites for a certain kind of land use. Such a map is a useful general guide for broad planning of a watershed, a wooded tract, or a wildlife area or for broad planning of recreation facilities, community developments, and engineering works. It is not a suitable map for detailed planning for management of a farm or field or for selecting a site for a road or building or other structure, because the soils within an association ordinarily vary in slope, depth, stoniness, drainage, and other characteristics that affect their management.

The soil associations in this survey area have been grouped into general kinds of landscapes for broad interpretative purposes. Each of the broad groups and the soil associations in each group are described on the following pages.

Soils on Foothills and Mountains

The soils in this group are shallow to deep, well-drained gravelly coarse sandy loams, clay loams, very stony loams, extremely stony loams, and silt loams. These soils formed in material that was derived from granite, loess, sandstone, limestone and shale. The slope is 0 to 65 percent, and elevation is 5,800 to 7,800 feet. The average annual precipitation ranges from 16 to 20 inches, and the frost-free season is 90 to 145 days. The native vegetation consists of ponderosa pine, mixed conifers, and foothill grasses and forbs.

The soils in this group are used for forest land and grazing. Large areas where the slope is less than 20 percent are used for dryland crops. Two soil associations are in this group.

1. Wetmore-Larkson-Pinata association

Deep to shallow, well drained gravelly sandy loams, stony loams, and very stony loams that formed in materials weathered from granite, loess, or sandstone

This soil association is in the southwestern and extreme western parts of the survey area. It is on hills, ridges, mesas, hillsides, and mountainsides. The slope is 5 to 65 percent. Permeability is slow to rapid, and the available water capacity is low to high.

This association makes up about 3 percent of the survey area. It consists of about 35 percent Wetmore soils, 30 percent Larkson soils, 15 percent Pinata soils, and 20 percent Mortenson and Vamer soils and Rock outcrop.

Wetmore soils have a slope of 40 to 50 percent and are shallow. These soils formed in residuum that weathered from granite bedrock. They are on mountain side slopes. The surface layer typically is gray gravelly coarse sandy loam about 6 inches thick. The subsoil is reddish-brown gravelly coarse sandy loam. Granite is at a depth of about 18 inches.

Larkson soils have a slope of 5 to 20 percent and are deep. These soils formed in residuum that weathered from sandstone. They are on hills and mountain side slopes. The surface layer typically is dark grayish-brown stony loam about 2 inches thick. The subsurface layer is light grayish-brown and brown stony loam about 3 inches thick. The subsoil is brown heavy clay loam about 36 inches thick. The underlying material is brown loam that extends to a depth of 60 inches or more.

Pinata soils have a slope of 25 to 65 percent and are deep. These soils formed in colluvium and residuum that weathered from sandstone. They are at the base of sandstone scarps and hogbacks. The surface layer

typically is gray very stony loam about 8 inches thick. The subsurface layer is brown very stony clay about 4 inches thick. The subsoil is reddish-brown very stony clay about 27 inches thick. The underlying material is reddish-brown very stony clay loam that extends to a depth of 60 inches or more.

The Mortenson and Vamer soils are the least extensive in this association. The Mortenson soils are deep very stony soils on steep mountainsides. The Vamer soils are shallow very stony soils on steep mountainsides.

The soils of this association are used for timber, grazing, wildlife habitat, recreation, and housing sites. The native vegetation consists of ponderosa pine and mixed conifers. The hazard of erosion is slight.

2. *Nunn-Stroupe-Holderness association*

Deep to shallow, well drained clay loams, extremely stony loams, and silt loams that formed in loess, alluvium, and materials weathered from sandstone, limestone, and shale

This soil association is in the western part of the survey area. It is on hills, ridges, mesas, and foothill slopes. The slope is 0 to 25 percent. Permeability is slow, and the available water capacity is high to low.

This association makes up about 4 percent of the survey area. It consists of about 60 percent Nunn soils, 14 percent Stroupe soils, 13 percent Holderness soils, and 13 percent Wormser, Denver, Neville, LaPorte, Nederland, and Table Mountain soils.

Nunn soils have a slope of as much as 9 percent and are deep. These soils formed in loess and residuum that weathered from sandstone. They are on uplands and mesas. The surface layer typically is grayish-brown clay loam about 9 inches thick. The subsoil is brown heavy clay loam to about 23 inches thick. The underlying material is pale-brown loam that extends to a depth of 60 inches or more.

Stroupe soils are moderately deep, and they formed in residuum that weathered from sandstone. They are on mesas, ridges, and upland plains. The surface layer typically is brown extremely stony loam about 9 inches thick. The subsoil is reddish-brown very stony clay loam about 16 inches thick. Sandstone bedrock is at a depth of about 25 inches.

Holderness soils are deep. They are on foothills and mesas. The surface layer typically is grayish-brown silt loam about 6 inches thick. The subsoil is brown heavy silty clay loam about 24 inches thick over brown clay loam 12 inches thick. The underlying material is light-brown loam about 6 inches thick. Sandstone is at a depth of 48 to 60 inches or more.

The Wormser, Denver, Neville, LaPorte, Nederland, and Table Mountain soils are the least extensive in this association. Wormser soils are moderately deep clayey soils that are underlain by sandstone bedrock. Denver soils are deep clayey soils that were derived from shale. LaPorte soils are shallow and are underlain by interbedded limestone and shale. Neville soils are deep sandy loam and loam soils that were derived from red sandstone. Nederland soils are deep cobbly soils on terrace edges. Table Mountain soils are deep alluvial soils on stream terraces.

The soils of this association are used for dryland wheat, feed crops, and grazing. The native vegetation consists of short and mid grasses of the foothills, such shrubs as mountainmahogany and skunkbush, pinyon pine, juniper, and Gambel oak. The hazard of erosion is slight.

Soils on Dissected Plains

The soils in this group are mainly shallow and moderately deep, excessively drained to well-drained channery loams, gravelly sandy loams, and loams. These soils formed in material that weathered from sandstone and limestone. The slope is as much as 90 percent, and elevation is 4,400 to 6,200 foot. The average annual precipitation is 12 inches, and the frost-free season is 130 to 175 days. The native vegetation mainly consists of short and mid grasses of the plains, pinyon pine, and juniper.

The soils in this group are used mostly for grazing, but management is difficult because of areas of Rock outcrop and steep slopes. Two soil associations are in this group.

3. *Travessilla association*

Shallow sandy loams that formed in material weathered from interbedded sandstone and shale

This soil association is in the southern and northwestern parts of the survey area. It is on hills, ridges, escarpments, and upland plain remnants. The slope is 1 to 90 percent. Permeability is moderate, and the available water capacity is low.

This association makes up about 5 percent of the survey area. It consists of about 60 percent Travessilla soils, 20 percent Rock outcrop, and 20 percent Kim, Wiley, and Haverson soils.

Travessilla soils have a slope of mostly 1 to 9 percent but range to more than 30 percent. These are shallow soils in areas along the rim of mesas and steep side slopes of canyons. The surface layer typically is pinkish-gray sandy loam 6 inches thick. The subsurface layer is light-brown sandy loam and light-brown loam. Sandstone is at a depth of 10 to 20 inches.

Rock outcrop is along the rim of mesas.

The Kim, Wiley, and Haverson soils are the least extensive in this association. The Kim soils are deep loam soils. The Wiley soils are deep silt loam soils that are underlain by sandstone at a depth of several feet. The Haverson soils are deep loam soils in drainageways.

The soils of this association are used for grazing. The native vegetation consists of short and mid grasses of the plains, juniper, pinyon pine, and scattered ponderosa pine. Grazing management is difficult because of the steep, rocky slopes. The hazard of erosion is moderate.

4. *Penrose-Minnequa association*

Shallow and moderately deep, somewhat excessively drained and well drained, channery loams and loams that formed in materials weathered from interbedded limestone and shale

This soil association is throughout the survey area except in the extreme western and northeastern parts.

It is on hills, ridges, escarpments, and mesas. The slope is 1 to 65 percent but is mainly 1 to 15 percent. Permeability is moderate, and the available water capacity is moderate to very low.

This association makes up about 15 percent of the survey area. It consists of about 55 percent Penrose soils, 15 percent Minnequa soils, 15 percent Rock outcrop, and 15 percent Manvel, Manzanola, and Midway soils.

Penrose soils have a slope of 1 to 65 percent and are shallow. They are in areas along the rim of mesas and escarpments. The surface layer typically is light brownish-gray channery loam about 3 inches thick. The subsurface layer is light-gray channery loam about 9 inches thick. Interbedded limestone and shale are at a depth of about 12 inches.

Minnequa soils have a slope of 1 to 3 percent and are moderately deep. They are on mesas. The subsurface layer is very pale brown loam about 6 inches thick. The underlying material is very pale brown silt loam about 22 inches thick. Limestone bedrock is at a depth of about 32 inches.

Rock outcrop is on the rim of mesas and on steep escarpments.

The Manvel, Manzanola, and Midway soils are the least extensive in this association. The Manvel soils are deep silt loam soils that formed in material that weathered from limestone. They are associated with Minnequa soils. The Manzanola soils are deep clayey soils that formed in alluvium that derived from limestone and shale. The Midway soils are shallow clayey soils that formed in material that weathered from shale.

The soils of this association are used for grazing, but range management is difficult because of the areas of Rock outcrop and the steep, rocky slopes. The native vegetation consists of short and mid grasses of the plains, forbs, pinyon pine, and juniper. The hazard of erosion is slight.

Soils on Plains

The soils in this group are deep to shallow, excessively drained to well-drained loamy sands to clays. These soils formed in residuum that weathered from sandstone, limestone, and shale and in eolian sand, loess, and alluvium. The slope is 0 to 9 percent, and elevation is 4,300 to 5,800 feet. The average annual precipitation is 12 inches, and the frost-free season is 130 to 175 days. The native vegetation consists of short and mid grasses of the plains.

The soils in this group are used for grazing, and they respond well to range management. Six soil associations are in this group.

5. Limon-Razor-Midway association

Deep to shallow, well drained silty clays, silty clay loams, clay loams, and clays that formed in materials weathered from shale

This soil association is in the north-central part of the survey area. It is on sedimentary upland plains and alluvial fans. The slope is 0 to 9 percent. The soils in this association are moderately to strongly saline-alkali. Permeability is slow, and the available water capacity is high to very low.

This association makes up about 13 percent of the survey area. It consists of about 30 percent Limon soils, 30 percent Razor soils, 25 percent Midway soils, and 15 percent Heldt soils.

Limon soils have a slope of 2 to 5 percent and are deep. They are on alluvial fans and terraces. The surface layer typically is grayish-brown silty clay loam about 14 inches thick. The underlying material is light brownish-gray silty clay loam that extends to a depth of 60 inches or more.

Razor soils have a slope of 1 to 5 percent and are moderately deep. They are on shale upland plains. The surface layer typically is light olive-brown heavy clay loam about 4 inches thick. The subsoil is grayish-brown silty clay about 11 inches thick. The underlying material is light brownish-gray clay about 15 inches thick. Light brownish-gray soft shale is at a depth of about 30 inches.

Midway soils have a slope of 1 to 9 percent and are shallow. They are on shale upland plains and small buttes. The surface layer is typically grayish-brown silty clay about 2 inches thick. The subsurface layer is light brownish-gray silty clay about 7 inches thick. Soft shale is at a depth of 9 to 20 inches.

The Heldt soils are the least extensive in this association. They are deep, heavy silty clay loam soils.

The soils of this association are used for grazing. They, especially the eroded soils, are a source of much sediment. The hazard of erosion is moderate, but some areas have been severely eroded by water.

6. Valent association

Deep, excessively drained loamy sands and sands that formed in eolian sand

This soil association is in the northeastern part of the survey area. It is on sandy upland plains and in some areas on low dunelike ridges. The slope is 2 to 7 percent. Permeability is very rapid, and the available water capacity is low.

This association makes up about 4 percent of the survey area. It consists of about 90 percent Valent soils and 10 percent Dwyer soils.

Valent soils typically have a surface layer of light brownish-gray loamy sand about 4 inches thick. The subsurface layer is pale-brown and very pale brown fine sand that extends to a depth of 60 inches or more.

Dwyer soils are similar to Valent soils, but they are calcareous at a depth of about 20 inches.

The soils of this association are used for grazing. The native vegetation is short and tall grasses and forbs of sandhills. The hazard of soil blowing is severe.

7. Olney-Vona association

Deep, well drained sandy loams and loamy sands that formed in eolian material

This soil association is in the northeastern part of the survey area. It is on sandy upland plains and high terraces. The parent material of these soils has been sorted by the wind. The slope is 0 to 5 percent. Permeability is moderate to rapid, and the available water capacity is high.

This association makes up about 9 percent of the survey area. It consists of about 50 percent Olney soils, 45 percent Vona soils, and 5 percent Otero and Stoneham soils.

Olney soils have a slope of 0 to 3 percent. The surface layer typically is light brownish-gray sandy loam about 8 inches thick. The subsoil is brown sandy clay loam about 8 inches thick. The underlying material is very pale brown sandy loam about 30 inches thick over very pale brown fine sandy loam that extends to a depth of 60 inches or more.

Vona soils have a slope of 0 to 5 percent. The surface layer typically is light brownish-gray sandy loam about 8 inches thick. The subsurface layer is brown sandy loam 12 inches thick. The underlying material is pale-brown sandy loam that extends to a depth of 60 inches or more.

The Otero and Stoneham soils are the least extensive in this association. The Otero soils are deep sandy loam soils that formed in mixed loamy alluvium on high terraces and alluvial fans. The Stoneham soils are deep loam soils that formed in mixed loamy alluvium on high terraces.

The soils of this association are used for grazing and dryland crops. The native vegetation consists of short and mid plains grasses. The hazard of soil blowing is high.

8. *Wiley-Kim association*

Deep, well drained loams and silt loams that formed in loess and loamy alluvium

This soil association is in the southern and northwestern parts of the survey area. It is on upland plains that are dissected by a few short ravines. Sandstone bedrock underlies this association at a depth of 40 inches or more. In the northwestern part of the survey area some areas are underlain by limestone or shale. The slope is 0 to 5 percent. Permeability is moderate or moderately slow, and the available water capacity is high.

This association makes up about 5 percent of the survey area. It consists of about 60 percent Wiley soils, 25 percent Kim soils, and 15 percent Travessilla and Manzanola soils.

Wiley soils have a slope of 1 to 4 percent and are 40 to 60 inches or more deep over interbedded sandstone and shale. The surface layer typically is light grayish-brown loam about 6 inches thick. The subsoil is pale-brown silty clay loam about 9 inches thick. The underlying material is pale-brown loam. Sandstone is at a depth of about 50 inches.

Kim soils have a slope of 0 to 5 percent and are 40 to more than 60 inches deep over sandstone. They are on low ridges, knolls, and alluvial fans. The surface layer typically is light brownish-gray loam about 5 inches thick. The subsurface layer is pale-brown loam about 10 inches thick. The underlying material is pale-brown silt loam or very pale brown loam that extends to a depth of 60 inches or more.

The Travessilla and Manzanola soils are the least extensive in this association. The Travessilla soils are shallow sandy loam or loam soils that are underlain by sandstone. They are on side slopes of ravines. The Manzanola soils are deep clay loam soils in swales or on terraces.

The soils of this association are used for grazing. The native vegetation consists of short plains grasses. Cane cactus grows abundantly in some parts of the association. The hazard of erosion is moderate.

9. *Manvel association*

Deep, well drained silt loams that formed in calcareous silty alluvium

This soil association is in all but the extreme western and northeastern parts of the survey area. It is on upland plains and old coalescing alluvial fans. Permeability is moderately slow, and the available water capacity is high.

This is the largest association in the survey area. It makes up about 30 percent of the survey area. It consists of about 80 percent Manvel soils and 20 percent Manzanola, Haverson, Baca, Shingle, and Absted soils.

Manvel soils have a slope of 0 to 5 percent and are deep. The surface layer typically is light grayish-brown silt loam about 9 inches thick. The underlying material is very pale brown silt loam that extends to a depth of 60 inches or more.

The Manzanola, Haverson, Baca, Shingle, and Absted soils are the least extensive in this association. The Manzanola soils are deep heavy silty clay loam and clay loam soils. The Baca soils are deep heavy silty clay loam soils. The Shingle soils are shallow loamy soils that are underlain by marl or soft shale. The Absted soils are deep heavy clay loam soils that are moderately alkaline or strongly alkaline.

The soils of this association are used for grazing. Small areas are included in irrigation systems. Some areas are used for dryland crops. The native vegetation is short grasses and forbs of the plains. The hazard of erosion is moderate.

10. *Stoneham-Adena-Manzanola association*

Deep, well drained loams, clay loams, sandy loams, and silty clay loams that formed in loess and in loamy and clayey alluvium

This soil association is in the north-central part of the survey area. It is on upland plains, mesas, and old alluvial fans that spread from the base of mesas. The slope is 0 to 9 percent. Permeability is slow or moderate, and the available water capacity is high.

This association makes up about 4 percent of the survey area. It consists of about 40 percent Stoneham soils, 15 percent Adena soils, 15 percent Manzanola soils, and 30 percent Otero, Gilcrest, and Manvel soils.

Stoneham soils have a slope of 0 to 3 percent and are deep. They are on the top of mesas. The surface layer typically is light brownish-gray loam about 4 inches thick. The subsoil is brown and pale-brown clay loam about 10 inches thick. The underlying material is very pale brown loam that extends to a depth of 60 inches or more.

Adena soils have a slope of 0 to 3 percent and are deep. They are on the top of mesas. The surface layer typically is light brownish-gray loam about 3 inches thick. The subsoil is brown clay loam about 5 inches

thick. It is underlain by light-brown silty clay loam about 4 inches thick and very pale brown silt loam that extends to a depth of 60 inches or more.

Manzanola soils have a slope of 0 to 9 percent and are deep. These soils formed in clayey alluvium. They are on old fans. The surface layer typically is light brownish-gray silty clay loam about 4 inches thick. The subsoil is grayish-brown heavy clay loam about 16 inches thick. The underlying material is pale-brown clay loam about 14 inches thick and pale-brown clay that extends to a depth of 60 inches or more.

The Otero, Gilcrest, and Manvel soils are the least extensive in this association. Otero and Gilcrest soils are associated with Manzanola soils. The Otero soils are deep gravelly sandy loam soils. The Gilcrest soils are deep sandy loam soils that are underlain by gravelly sand. The Manvel soils are deep, silty soils that are associated with Adena soils.

The soils of this association are used for grazing. The native vegetation consists of short plains grasses and forbs. The hazard of erosion is moderate.

Soils on Terraces and Flood Plains

The soils in this group are excessively drained to somewhat poorly drained sands and very gravelly sandy loams to silty clays. These soils formed in alluvium on flood plains and low terraces and terrace edges. The slope is 0 to 25 percent, and elevation is 4,300 to 6,000 feet. The average annual precipitation is 12 inches, and the frost-free season is 145 to 175 days. The native vegetation mainly consists of plains grasses and cottonwood trees.

The soils in this group are used for irrigated crops and irrigated and nonirrigated pasture. Three soil associations are in this group.

11. Cascajo-Schamber association

Deep, well drained to excessively drained gravelly sandy loams that formed in coarse textured alluvium on high terraces and terrace edges

This soil association is in the north-central part of the survey area. It is on ridges, terrace side slopes, escarpments, and gently undulating mesas. The slope is 5 to 25 percent. Permeability is rapid, and the available water capacity is low.

This association makes up about 4 percent of the survey area. It consists of about 70 percent Cascajo soils, 20 percent Schamber soils, and 10 percent Gilcrest and Midway soils and Shale outcrop.

Cascajo soils have a slope of 5 to 25 percent. They are on escarpments and terrace edges that border the Arkansas River Valley. The surface layer typically is light-brown very gravelly sandy loam about 10 inches thick. The subsurface layer is very pale brown very gravelly sandy loam about 10 inches thick. The underlying material is very pale brown stratified gravel and sand that extends to a depth of 60 inches or more. Shale is at a depth of 40 inches to several feet.

Schamber soils have a slope of 5 to 25 percent. They are on side slopes at the rim and base of mesas and on terraces that border Fountain Creek. The surface layer typically is grayish-brown gravelly sandy loam about 5 inches thick. The subsurface layer is grayish-brown very gravelly sandy loam about 4 inches thick. The underlying material is light brownish-gray very gravelly loamy sand about 26 inches thick. Below this is a very pale brown very gravelly loamy sand that extends to a depth of 60 inches or more.

The Gilcrest and Midway soils are the least extensive in this association. The Gilcrest soils, most of which are on Baculite Mesa, are deep gravelly sandy loam soils that are underlain by gravelly sand. The Midway soils are shallow clayey soils that are underlain by shale. They are associated with Shale outcrop.

The soils of this association are used for range. They also are a source of gravel. The hazard of erosion is slight.

12. Rocky Ford association

Deep, well drained silty clay loams that formed in silty alluvium on terraces

This soil association is on terraces along major drainageways. The slope is 0 to 3 percent.

This association makes up about 2 percent of the survey area. It consists of about 75 percent Rocky Ford soils and 25 percent Otero, Kim, and Manvel soils.

Rocky Ford soils are mostly cultivated and irrigated, and their surface layer has been thickened with silt sediments carried and deposited by irrigation water. The surface layer typically is grayish-brown silty clay loam about 12 inches thick. The subsoil and underlying material are pale-brown silt loam that extends to a depth of 60 inches or more.

The Otero, Kim, and Manvel soils are the least extensive in this association. The Otero soils have a surface layer of clay loam in irrigated areas because of the sediments carried and deposited by irrigation water. They have a surface layer of sandy loam where they are not farmed. The Manvel soils are silt loam soils. The Kim soils have a surface layer of fine sandy loam and a subsoil of loam.

The soils of this association are used for irrigated crops. The hazard of erosion is slight.

13. Las Animas-Glenberg-Apishapa association

Deep, somewhat poorly drained to well drained fine sandy loams and silty clays that formed in alluvium on flood plains

This soil association is along the major drainageways in the survey area. It is on river and creek bottom lands. The slope is 0 to 2 percent. Permeability is slow to moderately rapid, and the available water capacity is moderate or high.

This association makes up about 2 percent of the survey area. It consists of about 30 percent Las Animas soils, 30 percent Glenberg soils, 20 percent Apishapa soils, and 20 percent Haverson, Bankard, Gilcrest, and Limon soils.

Las Animas soils are somewhat poorly drained. The surface layer typically is very pale brown fine sandy loam about 6 inches thick. The subsurface layer is pale-brown stratified fine sand and fine sandy loam about 12 inches thick that has dark yellowish-brown and gray mottles. The underlying material, about 23 inches thick, is light brownish-gray fine sandy loam

that has dark-gray mottles. Below this is gray stratified silty clay loam and fine sandy loam that extends to a depth of 60 inches or more.

Glenberg soils are well drained. The surface layer typically is light brownish-gray fine sandy loam about 5 inches thick. The subsurface layer is pale-brown stratified fine sandy loam, loamy fine sand, and loam that extends to a depth of 60 inches or more.

Apishapa soils are somewhat poorly drained. The surface layer typically is grayish-brown silty clay about 8 inches thick. The subsurface layer is grayish-brown silty clay about 5 inches thick. The underlying material is grayish-brown clay about 16 inches thick. It is underlain by light brownish-gray clay that extends to a depth of 60 inches or more.

The Haverson, Bankard, Gilcrest, and Limon soils are the least extensive in this association. The Haverson soils are well-drained stratified silt loam and fine sandy loam soils. The Bankard soils are somewhat excessively drained sandy soils along river and creek bottoms. The Gilcrest soils are somewhat excessively drained sandy loam soils that are underlain by gravelly sand. The Limon soils are well-drained silty clay soils.

The soils of this association are used for grazing and for irrigated hay and feed crops. The native vegetation consists of salt-tolerant grasses of the plains, tamarisk, and cottonwood trees. The hazard of erosion is high.

Descriptions of the Soils

This section describes the soil series and mapping units in the Pueblo Area. Each soil series is described in detail and then, briefly, each mapping unit in that series. Unless specifically mentioned otherwise, it is to be assumed that what is stated about the soil series holds true for the mapping units in that series. Thus, to get full information about any one mapping unit, it is necessary to read both the description of the mapping unit and the description of the soil series to which it belongs.

An important part of the description of each soil series is the soil profile, that is, the sequence of layers from the surface downward to rock or other underlying material. The profile of each series is described twice. The first description is brief and in terms familiar to the layman. The second is much more detailed and is for those who need to make thorough and precise studies of soils. The profile described is representative of mapping units in a series. If the profile of a given mapping unit is different from the one described for the series, the differences are apparent in the name of the mapping unit, or the differences are stated in describing the mapping unit. Color terms are for dry soil unless otherwise stated.

As mentioned in the section "How This Survey Was Made," not all mapping units are members of a soil series. Eutroboralfs, for example, does not belong to a soil series but, nevertheless, is listed in alphabetic order along with the soil series.

Preceding the name of each mapping unit is a symbol. This symbol identifies the mapping unit on the detailed soil map. Listed at the end of each description of a mapping unit are the capability unit and range site to which the mapping unit has been assigned. The page for the description of each capability unit and range site can be learned by referring to the "Guide to Mapping Units" at the back of this survey.

The approximate acreage and proportionate extent of each mapping unit are shown in table 1. Many of the terms used in describing soils can be found in the Glossary, and more detailed information about the terminology and methods of soil mapping can be obtained from the Soil Survey Manual (*9*).[1]

Absted Series

The Absted series consists of deep, well-drained soils. These soils formed on uplands in clayey residuum that weathered from limestone and shale. The slope is 0 to 3 percent, and elevation is 4,400 to 4,900 feet. The average annual precipitation is 11 inches. The average annual temperature is 53° F, and the frost-free season is 145 to 175 days. The native vegetation is mainly short plains grasses.

In a representative profile the surface layer is light brownish-gray light clay loam about 2 inches thick. The upper part of the subsoil is brown heavy clay loam about 4 inches thick, and the lower part is pale-brown heavy silty clay loam about 7 inches thick. Below that is light yellowish-brown and very pale brown silty clay that extends to a depth of 60 inches or more.

Permeability is slow, and the available water capacity is high. The surface layer is moderately alkaline, and the subsoil and underlying material are moderately alkaline or strongly alkaline. The root zone extends to a depth of 40 inches or more. These soils are used for grazing.

Representative profile of Absted clay loam, in grass, one-fourth mile west of the southeast corner of sec. 4, T. 23 S., R. 60 W.

A2—0 to 2 inches, light brownish-gray (10YR 6/2) light clay loam, dark grayish brown (10YR 4/2) when moist; moderate, thin, platy structure; soft, very friable; nonsticky and slightly plastic; moderately alkaline; abrupt, smooth boundary.

B2t—2 to 6 inches, brown (10YR 5/3) heavy clay loam, dark brown (10 YR 4/3) when moist; weak, medium, columnar structure parting to moderate, fine, angular blocky; hard, firm; sticky and plastic; thin, nearly continuous, glossy coatings on peds; calcareous; moderately alkaline; clear, smooth boundary.

B3—6 to 13 inches, pale-brown (10YR 6/3) heavy silty clay loam, brown (10YR 5/3) when moist; weak, medium, prismatic structure parting to moderate, fine, subangular blocky; hard, firm; sticky and plastic; thin, nearly continuous, patchy, glossy coatings on peds; calcareous; moderately alkaline; gradual, smooth boundary.

C1cs—13 to 23 inches, light yellowish-brown (10YR 6/4) silty clay, yellowish brown (10YR 5/4) when moist; weak, medium, subangular blocky structure; hard, firm; sticky and plastic; calcareous; few fine filaments of crystalline gypsum; moderately alkaline; gradual, smooth boundary.

C2cs—23 to 60 inches, very pale brown (10YR 7/4) silty clay, yellowish brown (10YR 5/4) when moist; massive; very hard, firm; sticky and plastic; calcareous; few fine filaments of crystalline gypsum and small weathered shale fragments; moderately alkaline.

[1] Italic numbers in parentheses refer to Literature Cited, p. 89.

TABLE 1.—*Acreage and extent of the soils*

Soil	Area	Extent	Soil	Area	Extent
	Acres	*Percent*		*Acres*	*Percent*
Absted clay loam	10,825	0.7	Nunn clay loam, 5 to 9 percent slopes	4,450	.3
Adena-Manvel loams	14,190	.9	Olney loamy sand	13,235	.9
Apishapa silty clay	5,475	.4	Olney sandy loam	51,875	3.4
Arvada-Keyner association	10,885	.7	Otero sandy loam, 0 to 1 percent slopes	3,515	.2
Baca silty clay loam	13,805	.9	Otero sandy loam, 1 to 5 percent slopes	21,625	1.4
Bankard sand	5,675	.4	Otero gravelly sandy loam, 3 to 9 percent slopes	8,885	.6
Bloom silt loam	3,735	.2	Otero clay loam, 0 to 1 percent slopes	2,370	.2
Cascajo very gravelly sandy loam, 5 to 25 percent slopes	17,725	1.1	Otero clay loam, 1 to 3 percent slopes	3,165	.2
Cascajo-Shale outcrop complex, 5 to 30 percent slopes	9,580	.6	Penrose-Minnequa complex, 1 to 15 percent slopes	128,095	8.4
Denver clay loam, 3 to 9 percent slopes	2,205	.1	Penrose-Rock outcrop complex, 25 to 65 percent slopes	61,720	4.0
Dwyer loamy sand	9,025	.6	Pinata-Wetmore association	11,235	.7
Eutroboralfs, steep	2,450	.2	Razor clay loam	11,930	.8
Gilcrest sandy loam, 0 to 2 percent slopes	2,325	.2	Razor clay, eroded	43,715	2.9
Gilcrest gravelly sandy loam, 3 to 9 percent slopes	4,085	.3	Rocky Ford silty clay loam, 0 to 1 percent slopes	13,275	.9
Gilcrest complex, 3 to 6 percent slopes	7,715	.5	Rocky Ford silty clay loam, 1 to 3 percent slopes	8,535	.6
Glenberg-Haverson fine sandy loams	9,635	.6	Rocky Ford silty clay loam, wet	3,105	.2
Haverson silt loam	11,680	.8	Schamber gravelly sandy loam, 5 to 25 percent slopes	11,845	.8
Heldt silty clay loam, 2 to 6 percent slopes	26,505	1.7	Shingle silty clay loam, 1 to 9 percent slopes	11,965	.8
Holderness silt loam, 3 to 9 percent slopes	6,495	.4	Stoneham loam	31,690	2.1
Keyner loamy sand, wet	2,245	.1	Stroupe extremely stony loam, 9 to 25 percent slopes	7,145	.5
Kim fine sandy loam	9,800	.6	Table Mountain association	1,390	.1
LaPorte channery loam, 3 to 25 percent slopes	1,345	.1	Travessilla sandy loam, 1 to 9 percent slopes	40,445	2.6
Larkson loam, 6 to 12 percent slopes	6,860	.4	Travessilla-Rock outcrop complex, 30 to 90 percent slopes	28,280	1.9
Larkson stony loam, 5 to 20 percent slopes	3,265	.2	Valent loamy sand	52,735	3.5
Las Animas fine sandy loam	9,435	.6	Vamer-Rock outcrop complex, 5 to 25 percent slopes	2,125	.1
Limon silty clay loam, 0 to 2 percent slopes	38,510	2.5	Vona loamy sand	26,770	1.8
Limon silty clay loam, 2 to 5 percent slopes	1,265	.1	Vona sandy loam	25,745	1.7
Limon silty clay, 0 to 2 percent slopes	8,455	.6	Vona-Otero complex, eroded	9,965	.7
Limon silty clay, 0 to 5 percent slopes, gullied	9,025	.6	Wetmore-Mortenson association	9,005	.6
Manvel silt loam, 0 to 1 percent slopes	21,295	1.4	Wiley-Kim loams	62,620	4.1
Manvel silt loam, 1 to 5 percent slopes	364,125	23.8	Wormser silt loam	4,985	.3
Manvel silt loam, gullied	735	(1)	Gravel pits	125	(1)
Manvel silt loam, wet	1,715	.1	Water (includes 5,680 surface acres reserved for maximum water storage at Pueblo Reservoir.)	12,700	.8
Manzanola clay loam, 2 to 9 percent slopes	11,955	.8			
Manzanola silty clay loam, 0 to 2 percent slopes	27,420	1.8			
Midway-Shale outcrop complex, 1 to 9 percent slopes	49,535	3.2			
Minnequa-Manvel loams	26,810	1.8			
Nederland stony sandy loam, 9 to 25 percent slopes	1,025	.1			
Neville sandy loam, 3 to 9 percent slopes	1,960	.1			
Nunn stony loam, 3 to 9 percent slopes	735	(1)			
Nunn clay loam, 0 to 5 percent slopes	25,275	1.7	Total	1,527,070	100.0

[1] Less than 0.05 percent.

The A2 horizon is clay loam, silt loam, loam, or fine sandy loam as much as 4 inches thick. The B2t horizon is heavy clay loam or heavy silty clay loam 4 to 6 inches thick. The B3 horizon ranges from 4 to 8 inches thick and shale fragments make up as much as 5 percent. Soft shale is at a depth of 40 to 72 inches or more.

Ab—Absted clay loam. This soil is in the eastern half of the survey area. The slope is 0 to 3 percent. The areas are irregular in shape and cover as much as 800 acres. About 25 percent of the surface area is barren slickspots.

Included with this soil in mapping are areas of Minnequa-Manvel loams that make up about 10 percent of the acreage.

Runoff is medium, and the hazard of erosion is high.

This soil is better suited to grazing than to other uses. The native grasses are mainly alkali sacaton, blue grama, and galleta. Capability unit VIe–2, nonirrigated; Alkaline Plains range site.

Adena Series

The Adena series consists of deep, well-drained soils. These soils formed in loess on mesas. The slope is 0 to 3 percent, and elevation is 4,700 to 5,500 feet. The average annual precipitation is 12 inches. The average annual temperature is 53° F, and the frost-free season is 130 to 160 days. The native vegetation is mainly short plains grasses.

In a representative profile the surface layer is light brownish-gray loam about 3 inches thick. The upper part of the subsoil is brown clay loam about 5 inches thick, and the lower part is pale-brown silty clay loam

about 4 inches thick. Below that is very pale silt loam that extends to a depth of 60 inches or more.

Permeability is slow, and the available water capacity is high. The surface layer and upper part of the subsoil are mildly alkaline, and the lower part of the subsoil and the underlying material are moderately alkaline. The root zone extends to a depth of more than 60 inches. These soils are used for grazing.

Representative profile of Adena loam, in an area of Adena-Manvel loams, in native grass, 0.3 mile south and 200 feet west of the northeast corner of sec. 25, T. 19 S., R. 64 W.

A1—0 to 3 inches, light brownish-gray (10YR 6/2) loam, dark grayish brown (10YR 4/2) when moist; weak, thin, platy structure; slightly hard, very friable; slightly sticky and slightly plastic; mildly alkaline; abrupt, smooth boundary.

B2t—3 to 8 inches, brown (10YR 5/3) clay loam, dark brown (10YR 4/3) when moist; medium, prismatic structure parting to moderate, fine, angular blocky; very hard, firm; sticky and plastic; continuous, clay films on peds; mildly alkaline; clear, smooth boundary.

B3ca—8 to 12 inches, pale-brown (10YR 6/3) silty clay loam, dark brown (10YR 4/3) when moist; weak, medium, prismatic structure parting to moderate, fine, subangular blocky; hard, very friable; sticky and plastic; patchy, clay films on peds; calcareous; medium soft masses of lime; moderately alkaline; clear, wavy boundary.

C1ca—12 to 22 inches, very pale brown (10YR 7/3) silt loam, brown (10YR 5/3) when moist; weak, medium, prismatic structure parting to weak, medium, subangular blocky; hard, very friable; slightly sticky and slightly plastic; calcareous; medium soft masses of lime; moderately alkaline; gradual, smooth boundary.

C2—22 to 48 inches, very pale brown (10YR 7/3) silt loam, brown (10YR 5/3) when moist; weak, medium, prismatic structure; hard, very friable; slightly sticky and slightly plastic; calcareous; moderately alkaline; clear, smooth boundary.

C3—48 to 60 inches, very pale brown (10YR 7/4) silt loam, yellowish brown (10YR 5/4) when moist; massive; hard, very friable; slightly sticky and slightly plastic; calcareous; moderately alkaline.

The A horizon is silt loam, loam, or fine sandy loam 3 to 5 inches thick. The B2t horizon is clay loam or silty clay loam 2 to 6 inches thick. The B3ca horizon is at a depth of 9 to 15 inches.

Am—Adena-Manvel loams. This complex is in the northern part of the survey area. It is made up of about 60 percent Adena loam and 30 percent Manvel loam. The slope is 0 to 3 percent. Areas of this complex are irregular in shape and cover as much as 2,500 acres. Small pebbles are on the surface, and about 25 percent of the surface area of the Adena soil is small slickspots. The Adena soil is level, and the Manvel soil is slightly convex.

The Adena soil in this complex has the profile described as representative of the Adena series. The Manvel soil has a profile similar to the one described as representative of the Manvel series, but the surface layer is loam.

Included with these soils in mapping are areas of soils that are similar to this Adena soil, but the subsoil is about twice as thick. These included soils make up about 10 percent of the acreage.

Runoff is medium, and the hazard of erosion is moderate.

This complex is suited to grazing and has high potential for wildlife use if the habitat can be improved. The native vegetation is mainly blue grama and galleta. Cane cactus is abundant in places. Capability unit VIe–1, nonirrigated; Loamy Plains range site.

Apishapa Series

The Apishapa series consists of deep, somewhat poorly drained soils. These soils formed on flood plains in clayey alluvium. The slope is 0 to 2 percent, and elevation is 4,300 to 4,800 feet. The average annual precipitation is 12 inches. The average annual temperature is about 53° F, and the frost-free season is 145 to 175 days. The native vegetation is mainly salt-tolerant grasses.

In a representative profile the surface layer is grayish-brown silty clay about 8 inches thick. The upper part of the underlying material is grayish-brown silty clay about 5 inches thick, the next 16 inches is grayish-brown clay, and the lower part is light brownish-gray clay that extends to a depth of 60 inches or more.

Permeability is slow, and the available water capacity is high. The surface and subsurface layers are moderately alkaline, and the underlying material is strongly alkaline. The root zone extends to a depth of 60 inches or more. These soils are used for irrigated crops and hay and for irrigated or nonirrigated pasture.

Representative profile of Apishapa silty clay, in irrigated pasture, 0.44 mile south and 300 feet west of the northeast corner of sec. 8, T. 21 S., R. 61 W.

A1—0 to 8 inches, grayish-brown (10YR 5/2) silty clay, dark grayish brown (10YR 4/2) when moist; weak, coarse, granular structure; hard, firm; slightly sticky and plastic; calcareous; moderately alkaline; abrupt, smooth boundary.

C1cs—8 to 13 inches, grayish-brown (2.5Y 5/2) silty clay, dark grayish brown (2.5Y 4/2) moist; weak to moderate, fine, subangular blocky structure; hard, firm; slightly sticky and plastic; calcareous; few, fine, soft masses of crystalline gypsum; moderately alkaline; clear, smooth boundary.

C2cacsg—13 to 29 inches, grayish-brown (2.5Y 5/2) clay, dark grayish brown (2.5Y 4/2) when moist; few, faint, gray (2.5Y 5/1) mottles; massive; hard, firm; sticky and very plastic; calcareous; moderately alkaline; gradual, smooth boundary.

C3g—29 to 60 inches, light brownish-gray (2.5Y 6/2), dark grayish brown (2.5Y 4/2) when moist; common, fine, distinct, dark-gray (N 4/0) mottles; massive; hard, firm; sticky and very plastic; calcareous; strongly alkaline.

Cracks as much as one-half inch wide form when the soil dries out. The A horizon is silty clay loam or silty clay 4 to 8 inches thick. The C horizon is clay or silty clay. In places it has thin strata of sand, and in places wet sand is below a depth of 3½ feet. Gray mottles are at a depth of 12 to 20 inches.

Ap—Apishapa silty clay. This soil is mainly on flood plains of the Arkansas River. The areas are irregularly shaped and cover as much as 600 acres. This soil has the profile described as representative of the series, but in places 3 or 4 inches of fine sand is on the surface.

Included with this soil in mapping are areas of Glenberg fine sandy loam and Haverson fine sandy loam. These areas make up less than 10 percent of the acreage.

Runoff is slow, and the hazard of erosion is slight. In places the soil is subject to occasional, brief flooding. A seasonal high water table is at a depth of 2 to 3 feet. Aeration is poor below a depth of 2 or 3 feet because of the high water table. A low to moderate concentration of salts tends to accumulate from irrigation water or from evaporation of upward-moving capillary water from the seasonal high water table.

This soil is better suited to irrigated pasture than to other uses. The surface layer is difficult to cultivate because of the silty clay texture. The native grasses are alkali sacaton and inland saltgrass. Capability units IIIw–1, irrigated, and VIw–1, nonirrigated; Salt Meadow range site.

Arvada Series

The Arvada series consists of deep, well-drained soils. These soils formed on terraces in loamy alluvium derived mostly from mixed sedimentary rock. The slope is 0 to 4 percent, and elevation is 4,500 to 5,400 feet. The average annual precipitation is 12 inches. The average annual temperature is 53° F, and the frost-free season is 145 to 175 days. The native vegetation is mainly short plains grasses.

In a representative profile the surface layer is light brownish-gray sandy loam about 3 inches thick. The upper part of the subsoil is brown heavy clay loam about 2 inches thick, and the lower part is pale brown and very pale brown heavy clay loam about 12 inches thick. Below that is very pale brown light clay loam that extends to a depth of 60 inches or more.

Permeability is very slow, and the available water capacity is high. The surface layer and the upper part of the subsoil are moderately alkaline, and the lower part of the subsoil and the substratum are strongly alkaline. The root zone extends to a depth of 60 inches or more. These soils are used for grazing.

Representative profile of Arvada sandy loam, in an area of Arvada-Keyner association, in native grass, 0.2 mile south and 0.05 mile west of the northeast corner of sec. 30, T. 19 S., R. 63 W.

A2—0 to 3 inches, light brownish-gray (10YR 6/2) sandy loam, dark grayish brown (10YR 4/2) when moist; weak, very fine, granular structure; slightly hard, very friable; nonsticky and nonplastic; calcareous; moderately alkaline; abrupt, smooth boundary.

B21t—3 to 5 inches, brown (10YR 5/3) heavy clay loam, dark brown (10YR 4/3) when moist; moderate, medium, columnar structure; very hard, firm; slightly sticky and plastic; thin, continuous, clay films on peds; calcareous; moderately alkaline; clear, smooth boundary.

B22t—5 to 12 inches, pale-brown (10YR 6/3) heavy clay loam, brown (10YR 5/3) when moist; moderate, medium, subangular blocky structure; very hard, firm; slightly sticky and plastic; thin, continuous, clay films on peds; calcareous; strongly alkaline; clear, smooth boundary.

B3ca—12 to 17 inches, very pale brown (10YR 7/3) light clay loam, brown (10YR 5/3) when moist; moderate, medium, subangular blocky structure; hard, friable; slightly sticky and plastic; thin, patchy, clay films on peds; calcareous; few small masses of lime; strongly alkaline; clear, smooth boundary.

C1ca—17 to 43 inches, very pale brown (10YR 7/4) light clay loam, yellowish brown (10YR 5/4) when moist; weak, medium, subangular blocky structure; hard, firm; slightly sticky and plastic; calcareous; common, medium, soft masses of lime and fine threads of crystalline gypsum; strongly alkaline; gradual, smooth boundary.

C2—43 to 60 inches, very pale brown (10YR 7/4) light clay loam, yellowish brown (10YR 5/4) when moist; massive; hard, firm; sticky and plastic; calcareous; strongly alkaline.

The A horizon is sandy loam and loamy sand 3 to 8 inches thick. The B2t horizon is clay or heavy clay loam 6 to 9 inches thick. In places it is leached of lime to a depth of 11 inches.

AR—Arvada-Keyner association. This association is mostly in the northeastern part of the survey area. It is made up of about 55 percent Arvada sandy loam and 30 percent Keyner loamy sand. The slope is 0 to 4 percent. Areas of these soils are irregular in shape and cover as much as 600 acres. The Arvada soil is nearly level or slightly concave and is on broad terraces. The Keyner soil is on side slopes of terrace drainageways.

The Arvada and Keyner soils in this association have the profile described as representative of their series. On about 25 percent of the acreage erosion has removed the subsurface layer, leaving barren slickspots.

Included with these soils in mapping are areas of Limon silty clay loam that make up about 10 percent of the acreage and areas of Razor clay, eroded, that make up about 5 percent.

Runoff is slow on the Arvada soil and medium on the Keyner soil. The hazard of erosion is slight.

These soils have potential for wildlife habitat if water for wildlife is provided. The native grasses are mainly alkali sacaton, blue grama, and galleta. Fourwing saltbush, greasewood, and cactus are abundant in places. Capability unit VIe–2, nonirrigated; Arvada soil in Salt Flats range site; Keyner soil in Alkaline Plains range site.

Baca Series

The Baca series consists of deep, well-drained soils. These soils formed in loess on uplands. The slope is 0 to 3 percent, and elevation is 4,400 to 5,400 feet. The average annual precipitation is 12 inches. The average annual temperature is 53° F, and the frost-free season is 145 to 175 days. The native vegetation is mainly short plains grasses.

In a representative profile the surface layer is grayish-brown silty clay loam about 5 inches thick. The upper part of the subsoil is brown heavy silty clay about 8 inches thick, and the lower part is pale-brown silty clay loam about 8 inches thick. The underlying material is pale-brown silt loam and light yellowish-brown loam that extends to a depth of 60 inches or more.

Permeability is moderately slow, and the available water capacity is high. The surface layer and subsoil are mildly alkaline, and the underlying material is moderately alkaline. The root zone extends to a depth of more than 60 inches. These soils are used for grazing and irrigated crops.

Representative profile of Baca silty clay loam, in native grass, 0.3 mile east and 0.1 mile north of the southwest corner of sec. 34, T. 31 S., R. 66 W.

A1—0 to 5 inches, grayish-brown (10YR 5/2) silty clay loam, very dark grayish brown (10YR 3/2) when moist;

moderate, medium, granular structure parting to moderate, very fine, granular; soft, very friable; slightly sticky and slightly plastic; moderately alkaline; clear, smooth boundary.

B2t—5 to 13 inches, brown (10YR 5/3) heavy silty clay loam, dark brown (10YR 4/3) when moist; moderate, medium, subangular blocky structure parting to strong, very fine, subangular blocky; very hard, firm; sticky and plastic; continuous, clay films on peds; mildly alkaline; clear, smooth boundary.

B3ca—13 to 21 inches, pale-brown (10YR 6/3) silty clay loam, dark brown (10YR 4/3) when moist; moderate, fine, subangular blocky structure; very hard, friable; sticky and plastic; thin, continuous, clay films on peds; calcareous; common, soft, rounded masses of lime; moderately alkaline; clear, wavy boundary.

C1ca—21 to 34 inches, pale-brown (10YR 6/3) silt loam, brown (10 YR 5/3) when moist; weak, coarse, subangular blocky structure; hard, very friable; slightly sticky and slightly plastic when wet; calcareous; common, small, soft, rounded masses of lime and gypsum; moderately alkaline; clear, wavy boundary.

C2—34 to 48 inches, pale-brown (10YR 6/3) silt loam, brown (10YR 5/3) when moist; massive; slightly hard, very friable; nonsticky and slightly plastic; calcareous; common, small, rounded masses of crystalline gypsum; moderately alkaline; clear, wavy boundary.

C3—48 to 60 inches, light yellowish-brown (10YR 6/4) loam, yellowish brown (10YR 5/4) when moist; massive; soft, very friable; moist; nonsticky and slightly plastic; calcareous; common, small, rounded masses of crystalline gypsum; moderately alkaline.

The A and B horizons are 15 to 30 inches thick, and calcareous material is at a depth of 8 to 20 inches. The A horizon is silty clay loam or loam 3 to 5 inches thick. The B2t horizon is heavy silty clay loam or heavy clay loam 7 to 15 inches thick. Common, fine, soft, rounded masses of lime and gypsum are below a depth of 13 inches. The lowermost part of the C horizon is generally yellowish brown. Marl is several feet below the surface.

Bc—Baca silty clay loam. This soil is in the central and southeastern parts of the survey area. The slope is mostly 1 percent or less but ranges to 3 percent. The areas are irregularly shaped and cover as much as 200 acres.

Included with this soil in mapping are areas of Manvel soils that make up about 10 percent of the acreage.

Runoff is slow, and the hazard of erosion is slight. Runoff from surrounding higher lying lands tends to accumulate in areas of this soil.

This soil has a high potential for wildlife use if the habitat can be improved. The native grasses are mainly blue grama, galleta, and buffalograss. Capability units I, irrigated, and IVe–1, nonirrigated; Loamy Plains range site.

Bankard Series

The Bankard series consists of deep, somewhat excessively drained soils. These soils formed on flood plains in sandy alluvium. The slope is 0 to 2 percent, and elevation is 4,300 to 5,100 feet. The average annual precipitation is 12 inches. The average annual temperature is 53° F, and the frost-free season is 145 to 175 days. The native vegetation is mainly plains grasses.

In a representative profile (fig. 1) the surface layer is pale-brown sand about 4 inches thick. The underlying material is pale-brown stratified loamy sand, sand, and sandy loam about 26 inches thick over light grayish-brown stratified sand, loamy sand, and sandy loam that extends to a depth of 60 inches or more.

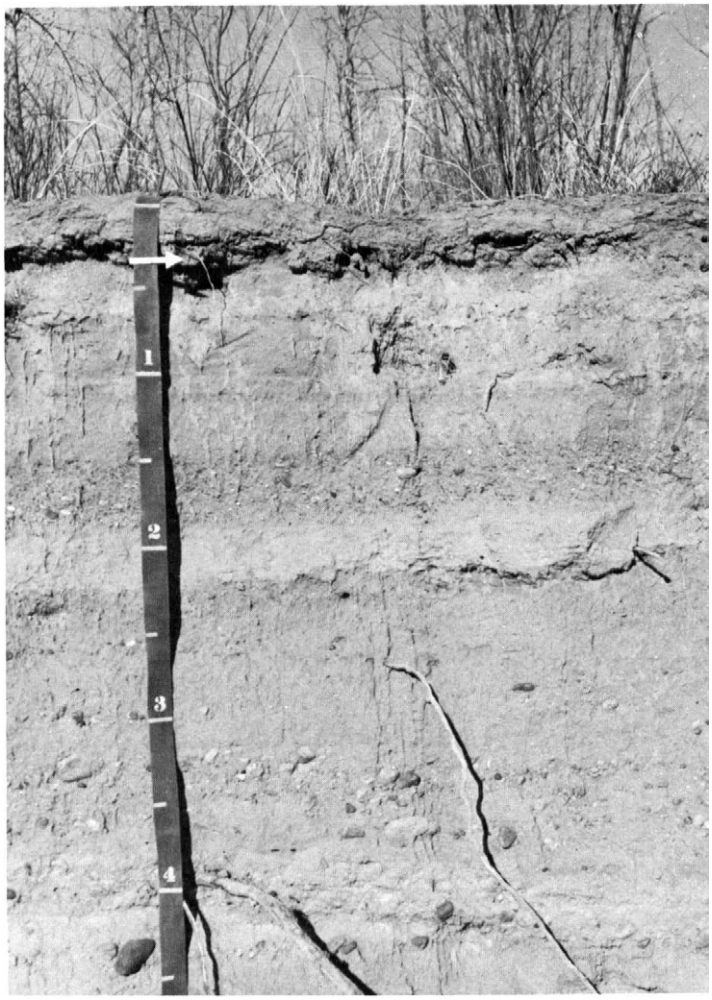

Figure 1.—**Profile of Bankard sand, showing stratification that is typical of soils that formed on flood plains. The strata range from sand to sandy loam.**

Permeability is rapid, and the available water capacity is low. These soils are moderately alkaline. Their root zone extends to a depth of more than 60 inches. They are used for grazing.

Representative profile of Bankard sand, in native grass, 0.35 mile west and 0.45 mile south of the northeast corner of sec. 3, T. 22 S., R. 60 W.

A1—0 to 4 inches, pale-brown (10YR 6/3) sand, brown (10YR 5/3) when moist; single grained; loose, very friable; nonsticky and nonplastic; calcareous; moderately alkaline; clear, smooth boundary.

C1—4 to 30 inches, pale-brown (10YR 6/3) loamy sand and thin strata, as much as 3 inches thick, of sandy loam or sand, brown (10YR 5/3) when moist; single grained; loose; nonsticky and nonplastic; 5 percent gravel; calcareous; moderately alkaline; clear, smooth boundary.

C2—30 to 60 inches, light grayish-brown (10YR 6/2) to very pale brown (10YR 7/3) stratified sand, loamy sand, and sandy loam, grayish brown (10YR 5/2) and has common, small, yellowish-brown (10YR 5/8) mottles

when moist; single grained; loose; nonsticky and nonplastic; 15 percent gravel; calcareous; moderately akaline.

The A horizon is sandy loam to sand 3 to 7 inches thick. The C horizon is variable in texture because of stratification, but it is mostly sand and loamy sand.

Bk—Bankard sand. This soil is along the major streams. The areas are elongated and cover as much as 100 acres.

Included with this soil in mapping are areas of Glenberg and Las Animas soils that make up about 10 percent of the acreage.

Runoff is slow, and the hazard of soil blowing is high. The soil is subject to frequent, brief flooding.

This soil has potential for wildlife use if the habitat can be improved. The native vegetation is wheatgrass, saltgrass, cottonwood, and willow. Capability unit VIw–2, nonirrigated; range site not assigned.

Bloom Series

The Bloom series consists of deep, somewhat poorly drained soils. These soils formed on flood plains in loamy alluvium. The slope is 0 to 2 percent, and elevation is 4,300 to 4,800 feet. The average annual precipitation is 12 inches. The average annual temperature is 53° F, and the frost-free season is 155 to 165 days. The native vegetation is mainly salt-tolerant grasses.

In a representative profile the surface layer is light brownish-gray silt loam about 8 inches thick and light-gray silty clay loam about 6 inches thick. The underlying material is light-gray silty clay loam about 21 inches thick. Below that it is light-gray and gray stratified silty clay loam and loamy very fine sand that extend to a depth of 60 inches or more.

Permeability is moderate, and the available water capacity is high. These soils are moderately alkaline. Their root zone extends to a depth of 60 inches or more. They are used for pasture and farming.

Representative profile of Bloom silt loam, in native grass, 0.4 mile south and 200 feet west of the northeast corner of sec. 5, T. 21 S., R. 62 W.

A1—0 to 8 inches, light brownish-gray (10YR 6/2) silt loam, dark grayish brown (10YR 4/2) and has few, fine, faint, yellowish-brown (10YR 5/4) mottles when moist; weak, thin, platy structure; hard, friable; slightly sticky and slightly plastic; many fine and very fine roots; calcareous; moderately alkaline; clear, smooth boundary.

A3g—8 to 14 inches, light-gray (10YR 7/2) silty clay loam, dark grayish brown (10YR 4/2) and has few, fine, faint, yellowish-brown (10YR 5/4) mottles when moist; weak, thick, platy structure; hard, firm; slightly sticky and slightly plastic; common fine and very fine roots; calcareous; moderately alkaline; abrupt, smooth boundary.

C1g—14 to 35 inches, light-gray (10YR 7/2) silty clay loam, dark gray (10YR 4/2) and has common, fine, faint, strong-brown (7.5YR 5/6) mottles when moist; weak, medium, angular blocky structure; hard, firm; slightly sticky and plastic; common fine and very fine roots; calcareous; moderately alkaline; clear, smooth boundary.

C2g—35 to 60 inches, light-gray and gray (10YR 7/2, 6/1) silty clay loam and thin seams of loamy very fine sand; dark greenish-gray (5GY 4/1) mottles and few, medium, strong-brown (7.5YR 5/6) mottles when moist; massive; hard, firm; nonsticky to slightly sticky; few very fine roots; calcareous; moderately alkaline.

The A and B horizons range from 10YR to 2.5Y in hue. The A1 horizon is variable in texture, but it is mostly silt loam or loam. The A3g and C1g horizons are mostly silty clay loam. The C horizon is silty clay loam stratified with thin seams of loamy very fine sand. It ranges from dark grayish brown, in hue of 2.5Y and 10YR, to greenish gray and bluish gray, in hue of 5GY and 5B. In places the Cg horizon is underlain by wet sand or fine gravel at a depth of 40 inches or more.

Bm—Bloom silt loam. This soil is along the major drainageways. The areas are elongated and cover as much as 400 acres.

Included with this soil in mapping are areas of Apishapa silty clay that make up about 10 percent of the acreage. Also included are small areas of soils that are similar to the Bloom soils but are poorly drained.

Runoff is slow, and the hazard of erosion is moderate. The soil is subject to occasional, brief flooding. The seasonal high water table is at a depth of 1.5 to 3 feet. There is a moderate to high concentration of salts, and salts tend to accumulate on the surface in areas where the capillary moisture from the ground water reaches the soil surface.

This soil has a high potential for pasture. The native grasses are mainly alkali sacaton and inland saltgrass. Willow and tamarisk grow in places. Capability units IIIw–1, irrigated, and VIw–1, nonirrigated; Salt Meadow range site.

Cascajo Series

The Cascajo series consists of deep, excessively drained soils. These soils formed on terraces in gravelly sandy alluvium. The slope is 5 to 25 percent, and elevation is 4,400 to 6,000 feet. The average annual precipitation is 12 inches. The average annual temperature is 53° F, and the frost-free season is 145 to 175 days. The native vegetation is mainly plains grasses.

In a representative profile (fig. 2) the surface layer is light-brown very gravelly sandy loam about 10 inches thick. The next layer is very pale brown very gravelly sandy loam about 11 inches thick. And below that is very pale brown stratified gravel and sand that extends to a depth of 60 inches or more.

Permeability is rapid, and the available water capacity is low. These soils are mildly alkaline to moderately alkaline. Their root zone extends to a depth of 60 inches or more. These soils are a source of gravel for commercial use.

Representative profile of Cascajo very gravelly sandy loam, 5 to 25 percent slopes, in native grass, 0.33 mile north of the south quarter corner of sec. 15, T. 21 S., R. 64 W.

A1—0 to 6 inches, light-brown (7.5YR 6/4) very gravelly sandy loam, dark brown (7.5YR 4/3) when moist; moderate, medium, granular structure; slightly hard, very friable; nonsticky and nonplastic; 60 percent gravel and cobbles; calcareous; moderately alkaline; clear, wavy boundary.

AC—6 to 10 inches, light-brown (7.5YR 6/4) very gravelly sandy loam, dark brown (7.5YR 4/3) when moist; weak, medium, subangular blocky structure; hard, very friable; nonplastic; 60 percent gravel and cobbles; calcareous; moderately alkaline; clear, irregular boundary.

C1ca—10 to 21 inches, very pale brown (10YR 8/3) very gravelly sandy loam, pale brown (10YR 6/3) when moist; single grained; hard, loose; nonsticky and nonplastic; 50 percent gravel, 20 percent cobbles; calcareous;

Figure 2.—**Profile of Cascajo very gravelly sandy loam.**

thick lime coatings on bottom of pebbles and cobbles; moderately alkaline; clear, wavy boundary.

C2–21 to 60 inches, very pale brown (10YR 7/3) stratified gravel and coarse sand, brown (10YR 5/3) when moist; single grained; loose; nonsticky and nonplastic; 50 percent gravel, 20 percent cobbles; calcareous; moderately alkaline.

The A1, AC, and C1ca horizons range from very gravelly sandy loam to very gravelly sand. Coarse fragments make up 35 to 80 percent of the C2 horizon, and 5 to 25 percent of these fragments are more than 3 inches in diameter.

CaE—Cascajo very gravelly sandy loam, 5 to 25 percent slopes. This soil is on high alluvial terraces along the major drainageways. The areas cover as much as 200 acres. This soil has the profile described as representative of the series, but in small areas in the southwestern part of the survey area along the Muddy Creek drainageway it has a thicker, darker colored surface layer, and in other areas on the Ft. Carson Military Reservation it is redder.

Included with this soil in mapping are areas of Cascajo-Shale outcrop complex in narrow strips on very steep side slopes along the Arkansas River. These areas make up about 20 percent of the acreage.

Runoff is moderately slow, and the hazard of erosion is slight.

This soil is a source of commercial gravel. In many places near Pueblo, the gravel is strip mined down to the underlying shale. This soil has potential for wildlife habitat. The native vegetation is mostly blue grama, sand dropseed, needleandthread, cactus, and yucca (fig. 3). Capability unit VIIs–2, nonirrigated; Gravel Breaks range site.

CsE—Cascajo-Shale outcrop complex, 5 to 30 percent slopes. This complex is on small shale knolls, ridges, spurs, and scarps that are capped with Cascajo very gravelly sandy loam. It is made up of about 60 percent Cascajo very gravelly sandy loam and 40 percent Shale outcrop and shale-derived material. Areas of this complex cover as much as 200 acres. Very steep areas of Shale outcrop are on the scarps. There is gravel along the rim of these areas.

Runoff is rapid, and the hazard of erosion is high. This complex has a sparse plant cover, and in most places it is severely eroded and dissected by gullies.

This complex is a limited source of gravel and has little value for grazing. It has potential for wildlife use if the habitat can be improved. Capability unit VIIs–2, nonirrigated; Cascajo soil in Gravel Breaks range site; Shale outcrop not assigned to a range site.

Denver Series

The Denver series consists of deep, well-drained soils. These soils formed on uplands in clayey alluvium or residuum that was derived from shale. The slope is 3 to 9 percent, and elevation is 6,000 to 7,200 feet. The average annual precipitation is 17 inches. The average annual temperature is 48° F, and the frost-free season is 115 to 145 days. The native vegetation is mainly plains grasses.

In a representative profile the surface layer is grayish-brown clay loam about 7 inches thick. The upper part of the subsoil is grayish-brown clay loam and clay about 15 inches thick, and the lower part is grayish-brown clay about 14 inches thick. The underlying layer is grayish-brown clay about 14 inches thick.

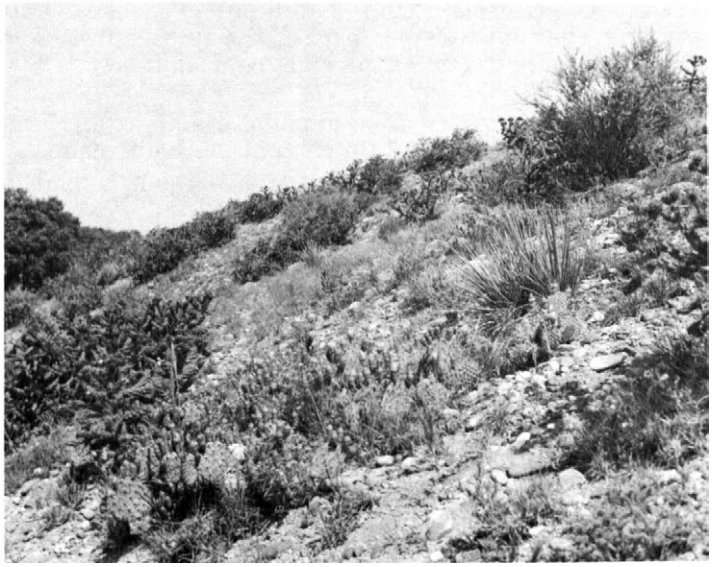

Figure 3.—**Cascajo soils can provide suitable food and cover for wildlife, but water is not available in many places.**

Below that is shale that extends to a depth of about 60 inches or more.

Permeability is slow, and the available water capacity is high. The surface layer is mildly alkaline, and the underlying material is moderately alkaline. The root zone extends to a depth of 40 inches or more. These soils are used for grazing and hay.

Representative profile of Denver clay loam, 3 to 9 percent slopes, in grass, about 400 feet north of the south quarter corner of sec. 30, T. 24, S., R. 67 W.

Ap—0 to 7 inches, grayish-brown (2.5Y 5/2) clay loam black (2.5Y 2/2) when moist; weak, fine, granular structure; slightly hard, friable; sticky and plastic; neutral; clear, smooth boundary.

B1—7 to 12 inches, grayish-brown (2.5Y 5/2) clay loam, black (2.5Y 2/2) when moist; weak to moderate, fine, subangular blocky structure; hard, friable; sticky and plastic; few, thin, patchy, clay films on peds; mildly alkaline; clear, smooth boundary.

B2t—12 to 22 inches, grayish-brown (2.5Y 5/2) clay, dark grayish brown (2.5Y 4/2) when moist; moderate, medium, prismatic structure parting to moderate, medium, subangular blocky; very hard, firm; sticky and very plastic; few, very faint, fine, olive-brown mottles in the lower part; thin, continuous, clay films on peds; mildly alkaline; clear, smooth boundary.

B3ca—22 to 36 inches, grayish-brown (2.5YR 5.2) clay, dark grayish brown (2.5Y 4/2) when moist; weak, coarse, prismatic structure parting to weak, medium, subangular blocky; very hard, firm; very sticky and very plastic; calcareous; fine soft masses of lime; moderately alkaline; diffuse, smooth boundary.

C1ca—36 to 50 inches, grayish-brown (2.5Y 5/2) clay, dark grayish brown (2.5Y 4/2) when moist; massive; very hard, firm; very sticky and very plastic; calcareous; common, soft, medium masses of lime; few weathered shale fragments in lower part; moderately alkaline; gradual, wavy boundary.

C2—50 to 60 inches, shale.

Depth to soft shale ranges from 40 inches to more than 60 inches. Depth to lime ranges from 15 to 30 inches. Mottles range from few and faint to many and distinct. Cracks as much as one-half inch wide extend from the surface into the B horizon when the soil dries out.

The A horizon ranges from silty clay loam to clay loam. The B horizon ranges from clay loam to clay.

DeD—Denver clay loam, 3 to 9 percent slopes. This soil is in the southwestern part of the survey area. The areas are irregular in shape and cover as much as 800 acres.

Included with this soil in mapping are areas of Nunn soils that make up about 20 percent of the acreage.

Runoff is rapid, and the hazard of erosion is moderate.

This soil is well suited to pasture. The native grasses are mainly western wheatgrass and blue grama. Capability units IIIe–2, irrigated, and VIe–4, nonirrigated; Clayey Foothills range site.

Dwyer Series

The Dwyer series consists of deep, excessively drained soils. These soils formed on uplands in windblown sand. The slope is 2 to 7 percent, and elevation is 4,700 to 5,000 feet. The average annual precipitation is 12 inches. The average annual temperature is 53° F, and the frost-free season is 145 to 175 days. The native vegetation is mainly plains grasses.

In a representative profile the surface layer is light brownish-gray loamy sand about 5 inches thick. The subsurface layer is brown loamy sand about 15 inches thick. Below that is very pale brown loamy sand that extends to a depth of 60 inches or more.

Permeability is very rapid, and the available water capacity is low. The surface layer and subsurface layers are mildly alkaline, and the underlying material is moderately alkaline. The root zone extends to a depth of more than 60 inches. These soils are used for grazing.

Representative profile of Dwyer loamy sand, in native grass, 0.2 mile north and 0.15 mile west of the southeast corner of sec. 19, T. 19 S., R. 64 W.

A1—0 to 5 inches, light brownish-gray (10YR 6/2) loamy sand, dark grayish brown (10YR 4/2) when moist; weak, coarse, granular structure; slightly hard, very friable; nonsticky and nonplastic; mildly alkaline; clear, smooth boundary.

AC—5 to 20 inches, brown (10YR 5/3) loamy sand, dark brown (10YR 4/3) when moist; weak, medium, subangular blocky structure; hard, very friable; nonsticky and nonplastic; mildly alkaline; clear, gradual boundary.

C2ca—20 to 45 inches, very pale brown (10YR 7/4) loamy sand, brown (10YR 5/3) when moist; single grained; hard, loose; nonsticky and nonplastic; calcareous; common, coarse, soft masses of lime; moderately alkaline; clear, gradual boundary.

C3—45 to 60 inches, very pale brown (10YR 7/4) loamy sand, brown (10YR 5/3) when moist; single grained; soft, loose; nonsticky and nonplastic; calcareous; moderately alkaline.

Depth to lime ranges from 12 to 40 inches. The A horizon is loamy sand 4 to 6 inches thick. The C horizon is generally somewhat coarser textured than the A horizon.

Dw—Dwyer loamy sand. This soil is in the northeastern part of the survey area. The slope is about 2 to 7 percent. The areas cover as much as 800 acres.

Included with this soil in mapping are areas of Otero soils that make up about 10 percent of the acreage and areas of Gilcrest soils that make up about 5 percent.

Runoff is slow, and the hazard of water erosion is severe, but the hazard of soil blowing is high.

This soil is better suited to grazing than to other uses. The native grasses are mainly side-oats grama, needlegrass, and sand dropseed. Yucca is also abundant. Capability unit VIe–3, nonirrigated; Deep Sand range site.

Eutroboralfs

EBF—Eutroboralfs, steep. This mapping unit is in the foothills in the western part of the country. The slope is mostly 10 to 65 percent but ranges to nearly vertical rock outcrops. This mapping unit consists of steep, deep, canyonlike drainageways through beds of sandstone or along escarpments formed by uptilted beds of sandstone. Stones, boulders, and some soil material have accumulated on the slopes. Rock outcrop is in places along the rims of canyons or escarpments. The mapping unit is made up of about 25 to 30 percent Rock outcrop.

The plant cover is ponderosa pine, pinyon pine, juniper, shrubs, forbs, and grasses that provide some light grazing. Capability unit VIIs–4, nonirrigated; range site not assigned.

Gilcrest Series

The Gilcrest series consists of deep, somewhat excessively drained soils. These soils formed on alluvial terraces and fans in sandy alluvium. The slope is 0 to 9 percent, and elevation is 4,400 to 5,300 feet. The average annual precipitation is 12 inches. The average annual temperature is 52° F, and the frost-free season is 130 to 160 days. The native vegetation is mainly plains grasses and forbs.

In a representative profile the surface layer is brown sandy loam about 4 inches thick. The upper part of the subsoil is pale-brown sandy loam about 23 inches thick, and the lower part is pale-brown gravelly coarse sandy loam about 8 inches thick. The underlying material is very pale brown gravelly sand that extends to a depth of 60 inches or more.

Permeability is rapid, and the available water capacity is low. The surface layer and subsoil are mildly alkaline, and the underlying material is moderately alkaline. The root zone extends to a depth of 60 inches or more. These soils are used for grazing.

Representative profile of Gilcrest sandy loam, 0 to 2 percent slopes, in grass, 0.25 mile east and 0.15 mile south of the northwest corner of sec. 5, T. 18 S., R. 62 W.

A1—0 to 4 inches, brown (7.5YR 5/2) sandy loam, dark brown (7.5YR 3/2) when moist; weak, medium, platy structure; slightly hard, very friable; slightly sticky and slightly plastic; many very fine roots; 5 percent gravel; mildly alkaline; clear, smooth boundary.

B2t—4 to 27 inches, pale-brown (10YR 6/3) sandy loam, dark brown (10YR 4/3) when moist; weak, medium, prismatic structure parting to moderate, medium, subangular blocky; hard, very friable; slightly sticky and slightly plastic; thin, patchy, clay films in pores and on sand grains; 10 percent gravel; mildly alkaline; clear, smooth boundary.

B3—27 to 35 inches, pale-brown (10YR 6/3) gravelly coarse sandy loam, brown (10YR 5/3) when moist; weak, medium, subangular blocky structure; hard, very friable; slightly sticky and slightly plastic; 15 percent gravel; mildly alkaline; clear, smooth boundary.

IIC—35 to 60 inches, very pale brown (10YR 7/3) gravelly sand, brown (10YR 5/3) when moist; single grained; loose; nonsticky and nonplastic; 20 percent gravel; calcareous; moderately alkaline.

Gravel makes up 5 to 25 percent of the A and B horizons and 15 to 35 percent of the IIC horizon. The A1 horizon is 3 to 8 inches thick. The B2t horizon is 10 to 30 inches thick. In places a prominent horizon of lime accumulation is below the B2t horizon. Depth to the IIC horizon ranges from 24 to 40 inches.

GcA—Gilcrest sandy loam, 0 to 2 percent slopes. This soil is on low alluvial terraces along streams. The areas are elongated and cover as much as 800 acres. This soil has the profile described as representative of the series.

Included with this soil in mapping are areas of Bankard sand, generally along the drainageways. These areas make up less than 10 percent of the acreage.

Runoff is slow, and the hazard of water erosion is slight, but the hazard of soil blowing is high. The soil is subject to occasional brief flooding.

This soil is used for grazing. The native vegetation is mainly blue grama, sand dropseed, rabbitbrush, cane cactus, and wild buckwheat. Capability unit VIe-3, nonirrigated; Sandy Plains range site.

GeD—Gilcrest gravelly sandy loam, 3 to 9 percent slopes. This soil is mostly on the top of mesas. The areas are irregular in shape and cover as much as 1,800 acres. This soil has a profile similar to the one described as representative of the series, but the surface layer is gravelly sandy loam. Also, the layer of clay accumulation is about 10 inches thick and about 25 percent of it is gravel. Beneath that is a prominent, but discontinuous, layer of lime accumulation about 9 inches thick that is about 35 percent gravel. The underlying material is gravelly loamy sand or gravelly sand that is about 15 percent gravel.

Included with this soil in mapping are areas of Schamber gravelly sandy loam. These included soils are in steeper areas and make up about 15 percent of the acreage.

Runoff is slow, and the hazard of water erosion is slight.

This soil is used for grazing. The native vegetation is mainly blue grama, side-oats grama, sand dropseed, needlegrass, sand sage, yucca, and buckwheat. Capability unit VIe–3, nonirrigated; Sandy Plains range site.

GfC—Gilcrest complex, 3 to 6 percent slopes. This complex is on fans at the foot of mesas in the northern part of the survey area. It is made up of about 70 percent Gilcrest sandy loam and of 15 percent soils that are similar to Gilcrest sandy loam but are underlain by shale at a depth of 20 to 40 inches. Areas of this complex are elongated and have concave slopes.

The Gilcrest soil in this complex has a profile similar to the one described as representative of the Gilcrest series, but it has less gravel and coarse sand.

Included with these soils in mapping are areas of Schamber gravelly sandy loam that make up about 10 percent of the acreage and areas of Razor clay loam that make up about 5 percent. The Schamber soils are on narrow ridges and steeper side slopes, and the Razor soils are on ridges and small knobs.

Runoff is slow, and the hazard of water erosion is slight.

These soils are used for grazing. The native vegetation is mainly blue grama, galleta, sand dropseed, cane cactus, vucca, and sand sage. Capability unit VIe–3, nonirrigated; Sandy Plains range site.

Glenberg Series

The Glenberg series consists of deep, well-drained soils. These soils formed on flood plains in loamy alluvium. The slope is 0 to 2 percent, and elevation is 4,300 to 4,800 feet. The average annual precipitation is 12 inches. The average annual temperature is 53° F, and the frost-free season is 145 to 175 days. The native vegetation is mainly plains grasses.

In a representative profile the surface layer is light brownish-gray fine sandy loam about 5 inches thick. Below that is pale-brown fine sandy loam stratified with loamy fine sand and loam that extends to a depth of 60 inches or more.

Permeability is moderately rapid, and the available water capacity is moderate. These soils are moderately alkaline. Their root zone extends to a depth of more

than 60 inches. They are used for grazing, hay, and irrigated crops.

Representative profile of Glenberg fine sandy loam, in an area of Glenberg-Haverson fine sandy loams, in native grass, 1,200 feet north and 800 feet east of the center of sec. 12, T. 19 S., R. 60 W.

A1—0 to 5 inches, light brownish-gray (10YR 6/2) fine sandy loam, dark grayish brown (10YR 4/2) when moist; weak, thin, platy structure; slightly hard, very friable; nonsticky and nonplastic; calcareous; moderately alkaline; abrupt, smooth boundary.

C—5 to 60 inches, pale-brown (10YR 6/3) fine sandy loam stratified with layers, less than 4 inches thick, of loamy fine sand and silt loam, brown (10YR 5/3) when moist; massive; slightly hard, very friable; nonsticky and nonplastic; calcareous; moderately alkaline.

In places there are a few, fine, distinct, strong-brown (7.5YR 5/6, moist) mottles below a depth of 21 inches. The A1 horizon is fine sandy loam to loamy fine sand 4 to 12 inches thick. The C horizon is mainly fine sandy loam thinly stratified with loamy fine sand and loam.

Gh—Glenberg-Haverson fine sandy loams. This complex is on low terraces along the rivers and creeks. It is made up of about 60 percent Glenberg fine sandy loam and 30 percent Haverson fine sandy loam. The slope is 0 to 2 percent. Areas of this complex are elongated and cover as much as 300 acres. The Glenberg soil is near the stream, and the Haverson soil is away from the stream.

The Glenberg soil in this complex has the profile described as representative of the Glenberg series. The Haverson soil has a profile similar to the one described as representative of the Haverson series, but the surface layer is fine sandy loam and the soil is redder.

Included with these soils in mapping are areas of Las Animas soils that make up about 10 percent of the acreage.

Runoff is slow, and the hazard of soil blowing is moderate. These soils are subject to occasional, brief flooding.

These soils have potential for nonirrigated pasture. They are easily tilled. The native vegetation is western wheatgrass, inland saltgrass, cottonwood, and tamarisk. Capability units IIe–1, irrigated, and VIe–1, nonirrigated; Sandy Bottomland range site.

Haverson Series

The Haverson series consists of deep, well-drained soils. These soils formed on flood plains in loamy alluvium. The slope is 0 to 2 percent, and elevation is 4,300 to 4,800 feet. The average annual precipitation is 12 inches. The average annual temperature is 53° F, and the frost-free season is 145 to 175 days. The native vegetation is mainly plains grasses.

In a representative profile the surface layer is light brownish-gray silt loam about 6 inches thick. The underlying material in the upper 9 inches is light brownish-gray silt loam. Below that it is pale-brown stratified silt loam, loam, and fine sandy loam that extends to a depth of 60 inches or more.

Permeability is moderate, and the available water capacity is high. These soils are moderately alkaline. Their root zone extends to a depth of more than 60 inches. They are used for grazing, hay, and irrigated crops.

Representative profile of Haverson silt loam, in native grass, 0.35 mile north and 0.05 mile east of the southwest corner of sec. 4, T. 26 S., R. 60 W.

A—0 to 6 inches, light brownish-gray (10YR 6/2) silt loam, dark grayish brown (10YR 4/2) when moist; weak, thin, platy structure parting to weak, fine, granular; soft, friable; nonsticky and slightly plastic; calcareous; moderately alkaline; abrupt, smooth boundary.

C1—6 to 15 inches, light brownish-gray (10YR 6/2) silt loam, dark grayish brown (10YR 4/2) when moist; weak, medium, subangular blocky structure; slightly hard, friable; nonsticky and slightly plastic; calcareous; moderately alkaline; clear, smooth boundary.

C3—15 to 60 inches, pale-brown (10YR 6/3) stratified silt loam, loam, and fine sandy loam, brown (10YR 4/3) when moist; massive; hard, friable; nonsticky and slightly plastic; calcareous; moderately alkaline.

The A horizon is loam, silt loam, silty clay loam, or fine sandy loam 3 to 12 inches thick. The C horizon is stratified silt loam, loam, fine sandy loam, and silty clay loam.

Ha—Haverson silt loam. This soil is on low terraces or bottoms of intermittent drainageways in the eastern part of the survey area. The areas are elongated and cover as much as 200 acres.

Included with this soil in mapping are small areas of Glenberg and Bankard soils.

Runoff is slow, and the hazard of erosion is slight. The soil is subject to frequent, very brief flooding.

This soil has potential for nonirrigated pasture. The native vegetation is mainly western wheatgrass, blue grama, alkali sacaton, and fourwing saltbush. Capability units IIw–1, irrigated, VIw–2, nonirrigated; Saline Overflow range site.

Heldt Series

The Heldt series consists of deep, well-drained soils. These soils formed on alluvial fans in clayey alluvium. The slope is 2 to 6 percent, and elevation is 4,800 to 5,600 feet. The average annual precipitation is 12 inches. The average annual temperature is 53° F, and the frost-free season is 145 to 175 days. The native vegetation is mainly short plains grasses.

In a representative profile the surface layer is light brownish-gray silty clay loam about 3 inches thick. The subsoil is light yellowish-brown silty clay about 11 inches thick.The underlying material is light yellowish-brown silty clay about 9 inches thick over pale-yellow silty clay that extends to a depth of 60 inches or more.

Permeability is slow, and the available water capacity is high. These soils are moderately alkaline. Their root zone extends to a depth of 40 inches or more. They are used for grazing.

Representative profile of Heldt silty clay loam, 2 to 6 percent slopes, in native grass, 0.3 mile east of the west quarter corner of sec. 14, T. 20 S., R. 65 W.

A1—0 to 3 inches, light brownish-gray (2.5Y 6/2) silty clay loam, dark grayish brown (2.5Y 4/2) when moist; weak, thin, platy structure parting to moderate, very fine, granular; slightly hard, firm; sticky and plastic; calcareous; moderately alkaline; abrupt, smooth boundary.

B2—3 to 14 inches, light yellowish-brown (2.5Y 6/4) silty clay, olive brown (2.5Y 4/4) when moist; moderate, medium, prismatic structure parting to moderate, medi-

um, subangular blocky; hard, firm; sticky and plastic; thin, patchy, clay films on vertical faces of peds; calcareous; moderately alkaline; clear, wavy boundary.

C1cs—14 to 23 inches, light yellowish-brown (2.5Y 6/4) silty clay, olive brown (2.5Y 4/4) when moist; weak, fine, angular blocky structure; hard, firm; sticky and plastic; calcareous; segregated gypsum in seams and threads; moderately alkaline; gradual, smooth boundary.

C2—23 to 60 inches, pale-yellow (2.5Y 7/4) silty clay, yellowish brown (10YR 5/4) when moist; massive; slightly hard, firm; sticky and plastic; calcareous; scattered powdered lime and fine crystalline gypsum; moderately alkaline.

The A1 horizon is silty clay loam to silty clay or clay 3 to 5 inches thick. The B2 horizon is clay, silty clay, or heavy clay loam 7 to 27 inches thick. A few cracks, as much as one-half inch wide, extend from the surface into the B2 horizon when the soil dries out. In some places there is no Ccs horizon. Shale is at a depth of 40 inches to several feet.

He—Heldt silty clay loam, 2 to 6 percent slopes. This gently sloping soil is on alluvial fans below outcrops of limestone or shale. The areas are elongated and cover as much as 600 acres. This soil has the profile described as representative of the series, but in the western part of the survey area the surface layer and subsoil are generally clay. The clay is hard or very hard when dry and very firm when moist.

Included with this soil in mapping are areas of Wiley-Kim loams that make up about 5 percent of the acreage. Also included are areas of Razor clay loam that make up about 5 percent.

Runoff is rapid, and the hazard of erosion is high.

This soil is used mostly for grazing. The native grasses are mainly blue grama, galleta, and western wheatgrass. Capability unit VIe–2, nonirrigated; Alkaline Plains range site.

Holderness Series

The Holderness series consists of deep, well-drained soils. These soils formed on foothill slopes in loess and residuum that derived from sandstone. The slope is 3 to 9 percent, and elevation is 6,500 to 7,200 feet. The average annual precipitation is 18 inches. The average annual temperature is 45° F, and the frost-free season is 125 to 135 days. The native vegetation is mainly foothills grasses.

In a representative profile the surface layer is grayish-brown silt loam about 6 inches thick. The upper part of the subsoil is brown heavy silty clay loam about 24 inches thick, and the lower part is brown clay loam about 12 inches thick. The underlying material is light-brown loam. Sandstone is at a depth of 48 inches.

Permeability is slow, and the available water capacity is high. The surface and subsurface layers are neutral, and the underlying material is moderately alkaline. The root zone extends to a depth of 40 to 60 inches or more. These soils are used for grazing, hay, and small grain.

Representative profile of Holderness silt loam, 3 to 9 percent slopes, in native grass, 0.4 mile south and 300 feet west of the northeast corner of sec. 26, T. 22 S., R. 68 W.

A1—0 to 6 inches, grayish-brown (10YR 5/2) silt loam, very dark brown (10YR 2/2) when moist; moderate, medium, granular structure; soft, very friable; nonsticky and slightly plastic; neutral; clear, smooth boundary.

B1—6 to 10 inches, brown (7.5YR 5/3) silty clay loam, dark brown (7.5YR 3/2) when moist; moderate, fine, angular blocky structure; hard, friable; sticky and plastic; nearly continuous clay films on peds; neutral; clear, smooth boundary.

B2t—10 to 30 inches, brown (7.5YR 5/3) heavy silty clay loam, dark brown (7.5YR 4/3) when moist; moderate, medium, prismatic structure parting to strong, medium, angular blocky; hard, firm; sticky and very plastic; patchy clay films on peds; mildly alkaline; clear, gradual boundary.

B3—30 to 42 inches, brown (7.5YR 5/2) clay loam, brown (7.5YR 4/2) when moist; weak, medium, prismatic structure parting to moderate, medium, subangular blocky; hard, friable; sticky and plastic; patchy clay films on peds; mildly alkaline; clear, gradual boundary.

Cca—42 to 48 inches, light-brown (7.5YR 6/4) loam, brown (7.5YR 4/4) when moist; massive; hard, friable; sticky and plastic; strongly calcareous; fine filaments or threads of lime; moderately alkaline, abrupt, smooth boundary.

IIR—48 inches, sandstone.

The A1 horizon is silt loam to loam 4 to 8 inches thick. The dark-colored surface layer ranges from 8 to 16 inches thick. The B horizon is heavy clay loam or silty clay loam 18 to 38 inches thick. It has a hue of 7.5YR or 10YR and chroma of 2 to 4. Depth to the IIR horizon of sandstone or to a IIC horizon of red clay ranges from 40 to 72 inches or more. Depth to free lime is more than 40 inches. In places as much as 10 percent of the material is coarse channery sandstone.

Ho—Holderness silt loam, 3 to 9 percent slopes. This soil is on foothills in the western part of the survey area. The slope is mostly more than 5 percent. The areas are irregular in shape and cover as much as 600 acres. This soil has the profile described as representative of the series, but in small swales the surface layer is somewhat thicker.

Included with this soil in mapping are areas of Nunn soils at lower elevations and on exposures that have a higher average annual soil temperature. These areas make up about 10 percent of the acreage. Also included are areas of Stroupe soils that make up about 5 percent of the acreage.

Runoff is moderate or rapid, and the hazard of erosion is high. Gully erosion is common.

This soil is suited to pasture and grazing. The native grasses are mainly bluegrass and wheatgrass. Capability unit IVe–3, nonirrigated; Loamy Park range site.

Keyner Series

The Keyner series consists of deep, well-drained soils. These soils formed on terraces in loamy alluvium. The slope is 2 to 4 percent, and elevation is 4,500 to 5,400 feet. The average annual precipitation is 12 inches. The average annual temperature is 53° F, and the frost-free season is 145 to 175 days. The native vegetation is mainly plains grasses.

In a representative profile the surface layer is light brownish-gray loamy fine sand about 5 inches thick. The subsoil is pale-brown sandy clay loam about 10 inches thick. The underlying material is very pale brown or light brownish-gray sandy clay loam or clay loam about 9 inches thick. Below that it is light-gray or very pale brown sandy loam that extends to a depth of 60 inches or more.

Permeability is slow, and the available water capacity is high. The surface layer and subsoil are moder-

ately alkaline, and the underlying material is strongly alkaline. The root zone extends to a depth of more than 60 inches. These soils are used for grazing.

Representative profile of Keyner loamy sand, in an area of Arvada-Keyner association, in native grass, 500 feet west and 500 feet north of the southeast corner of sec. 26, T. 19 S., R. 62 W.

A2—0 to 5 inches, light brownish-gray (10YR 6/2) loamy fine sand, dark grayish brown (10YR 4/2) when moist; single grained; loose; nonsticky and nonplastic; moderately alkaline; abrupt, smooth boundary.

B21t—5 to 9 inches, pale-brown (10YR 6/3) sandy clay loam, dark brown (10YR 4/3) when moist; moderate, medium, columnar structure; very hard, friable; slightly sticky and plastic; thin, nearly continuous, clay films on peds; calcareous; moderately alkaline; clear, smooth boundary.

B22t—9 to 15 inches, pale-brown (10YR 6/3) sandy clay loam, brown (10YR 5/3) when moist; moderate, medium, prismatic structure; very hard, friable; slightly sticky and plastic; thin, patchy, clay films on peds; calcareous; strongly alkaline; clear, smooth boundary.

C1ca—15 to 19 inches, very pale brown (10YR 7/3) sandy clay loam, brown (10YR 5/3) when moist; moderate, medium, prismatic structure; very hard, friable; slightly sticky and plastic; calcareous; common, large, soft masses of lime; strongly alkaline; gradual, wavy boundary.

C2ca—19 to 24 inches, light brownish-gray (2.5Y 6/2) heavy clay loam, dark grayish brown (2.5Y 4/2) and has common, medium, strong-brown (7.5YR 5/6) mottles when moist; weak, medium, subangular blocky structure; very hard, firm; sticky and very plastic; common, large, soft masses of lime; strongly alkaline; gradual, wavy boundary.

C3—24 to 44 inches, light-gray (2.5Y 7/2) sandy loam, grayish brown (2.5Y 5/2) and has common, small, strong-brown (7.5Y 5/6) mottles when moist; weak, medium, subangular blocky structure; slightly hard, very friable; nonsticky and slightly plastic; calcareous; strongly alkaline; gradual, wavy boundary.

C4—44 to 60 inches, very pale brown (10YR 7/3) sandy loam, brown (10YR 5/3) and has a few, small, strong-brown (7.5Y 5/6) mottles when moist; single grained; slightly hard, very friable; nonsticky and slightly plastic; calcareous; strongly alkaline.

The A horizon is sandy loam to loamy sand as much as 9 inches thick. The B2t horizon is sandy clay loam to clay loam 7 to 15 inches thick. The B21t horizon ranges from moderately alkaline to strongly alkaline. The C horizon is stratified and in places has layers of sand. In places there is a Cg horizon between depths of 30 and 40 inches.

Ke—Keyner loamy sand, wet. This soil is mostly on the flood plains of Chico Creek in the northeastern part of Pueblo County. The areas are rectangular in shape and cover as much as 1,000 acres. This soil has a profile similar to the one described as representative of the series, but the subsoil is thicker and the substratum is stratified sandy loam and gravelly sand. Also, erosion has removed the surface layer on about 5 percent of the acreage, leaving barren slickspots.

Included with this soil in mapping are areas of a poorly drained clayey soil in narrow, winding swales where the water table is at a depth of 18 inches. Also included are areas of Glenberg and Haverson soils near drainageways and areas of Limon soils on low benches. These included soils make up about 25 percent of the acreage.

Runoff is slow, and the hazard of erosion is moderate. The soil is subject to occasional, brief flooding. The water table is at a depth of 2 to 4 feet. There is a moderate to high concentration of salts in the soil.

This soil has potential for waterfowl use if the habitat can be improved. The native vegetation is mainly alkali sacaton, inland saltgrass, greasewood, fourwing saltbush, and cactus. Capability unit VIw–1; Salt Meadow range site.

Kim Series

The Kim series consists of deep, well-drained soils. These soils formed on alluvial fans in loamy alluvium. The slope is 0 to 5 percent, and elevation is 4,600 to 5,000 feet. The average annual precipitation is 12 inches. The average annual temperature is 53° F, and the frost-free season is 145 to 175 days. The native vegetation is mainly plains grasses.

In a representative profile the surface layer is light brownish-gray loam about 5 inches thick. The upper part of the underlying material is pale brown loam about 10 inches thick, the next part is very pale brown silt loam 20 inches thick, and the lower part is very pale brown loam that extends to a depth of 60 inches or more.

Permeability is moderate, and the available water capacity is high. These soils are moderately alkaline. Their root zone extends to a depth of 40 to 60 inches or more. They are used for grazing.

Representative profile of Kim loam, in an area of Wiley-Kim loams, in grass, 0.35 mile north and 0.35 mile east of the southwest corner of sec. 21, T. 26 S., R. 60 W.

A1—0 to 5 inches, light brownish-gray (10YR 6/2) loam, dark grayish brown (10YR 4/2) when moist; weak, medium, platy structure parting to moderate, fine, granular; slightly hard, very friable; nonsticky and slightly plastic; calcareous; moderately alkaline; abrupt, smooth boundary.

AC—5 to 15 inches, pale-brown (10YR 6/3) loam, brown (10YR 5/3) when moist; weak, medium, prismatic structure parting to moderate, fine, subangular blocky; slightly hard, very friable; nonsticky and slightly plastic; calcareous; moderately alkaline; clear, wavy boundary.

C1ca—15 to 35 inches, very pale brown (10YR 7/3) silt loam, brown (10YR 5/3) when moist; weak, medium, prismatic structure parting to moderate, fine, angular blocky; hard, very friable; nonsticky and slightly plastic; calcareous; fine, generally rounded, soft masses of lime; moderately alkaline; gradual, smooth boundary.

C2—35 to 52 inches, very pale brown (10YR 8/4) loam, yellowish brown (10YR 5/4) when moist; weak, fine, subangular blocky structure; slightly hard, very friable; nonsticky and slightly plastic; calcareous; moderately alkaline; clear, wavy boundary.

C3cs—52 to 60 inches, very pale brown (10YR 8/4) loam, light yellowish brown (10YR 6/4) when moist; massive; slightly hard, very friable; nonsticky and slightly plastic; calcareous; scattered, fine crystalline gypsum; moderately alkaline.

The A horizon is loam to sandy loam 3 to 6 inches thick. Coarse fragments make up as much as 15 percent of the soil, and they are commonly small sandstone fragments. The AC horizon is loam to sandy loam 6 to 10 inches thick. The C horizon ranges from loam to silt loam but is generally loam. Depth to sandstone ranges from 40 inches to several feet. In places calcareous cobbly gravel is below a depth of 40 inches.

Kim soils in the Pueblo Area are mapped mostly with Wiley soils.

Km—Kim fine sandy loam. This nearly level soil is on terraces along the south side of the Arkansas River.

The areas are elongated and cover as much as 300 acres. This soil has a profile similar to the one described as representative of the series, but the surface and subsurface layers are fine sandy loam and in most places limy gravelly sand is at a depth of about 5 feet.

Included with this soil in mapping are areas of Otero and Manvel soils. Each of these soils makes up about 10 percent of the acreage.

Runoff is slow. The hazard of erosion is slight in irrigated areas and moderate in nonirrigated areas.

This soil is well suited to vegetable gardens and irrigated crops. The native grasses are mainly blue grama and sand dropseed. Capability units I, irrigated, VIe–1, nonirrigated; Loamy Plains range site.

LaPorte Series

The LaPorte series consists of shallow, well-drained soils. These soils formed on upland hills and ridges in loamy residuum that derived from limestone. The slope is 3 to 25 percent, and elevation is 6,200 to 7,000 feet. The average annual precipitation is 16 inches. The average annual temperature is 48° F, and the frost-free season is 125 to 145 days. The native vegetation is mainly foothill grasses.

In a representative profile the surface layer is grayish-brown channery loam about 7 inches thick. The subsurface layer is light brownish-gray loam about 6 inches thick. The underlying material is very pale brown channery loam about 4 inches thick. Below that is argillaceous limestone.

Permeability is moderate, and the available water capacity is very low. These soils are moderately alkaline. Their root zone extends to a depth of 10 to 20 inches. They are used for grazing.

Representative profile of LaPorte channery loam, 3 to 25 percent slopes, in native grass, 0.1 mile west and 300 feet north of the southeast corner of sec. 36, T. 24 S., R. 67 W.

A1—0 to 7 inches, grayish-brown (10YR 5/2) channery loam, very dark grayish brown (10YR 3/2) when moist; weak, fine, granular; slightly hard, friable; nonsticky and slightly plastic; 25 percent small limestone fragments; calcareous; moderately alkaline; clear, smooth boundary.

AC—7 to 13 inches, light brownish-gray (10YR 6/2) loam, dark grayish brown (10YR 4/2) when moist; weak, medium, subangular blocky structure; slightly hard, friable; nonsticky and slightly plastic; calcareous; 10 percent small limestone fragments; moderately; alkaline; clear, smooth boundary.

Cca—13 to 17 inches, very pale brown (10YR 7/3) channery loam, brown (10YR 5/3) when moist; massive; hard, friable; nonsticky and slightly plastic; calcareous; 25 to 35 'percent small limestone fragments; moderately alkaline; gradual, wavy boundary.

R—17 inches, argillaceous limestone.

Content of rock fragments ranges from 10 to 35 percent. Depth to bedrock ranges from 10 to 20 inches.

LaE—LaPorte channery loam, 3 to 25 percent slopes. This soil is in the southwestern part of the survey area. The areas are long, narrow, and irregular in shape and cover as much as 600 acres.

Included with this soil in mapping are areas of Penrose soils and Rock outcrop that make up about 20 percent of the acreage. Also included are small areas of Denver and Table Mountain soils that make up about 5 percent.

Runoff is rapid, and the hazard of erosion is high.

This soil has potential for wildlife use if the habitat can be improved. The native vegetation is indian ricegrass, needleandthread, junegrass, blue grama, mountainmahogany, and Gambel oak. Capability unit VIIs–3, nonirrigated; Shallow Foothills range site.

Larkson Series

The Larkson series consists of deep, well-drained soils. These soils formed on upland fans, hills, and slopes in loess and loamy residuum weathered from sandstone. The slope is 5 to 20 percent, and elevation is 6,500 to 7,800 feet. The average annual precipitation is 18 inches. The average annual temperature is 43° F, and the frost-free season is 100 to 130 days. The native vegetation is mainly forest plants of the lower mountains.

In a representative profile the surface layer is dark grayish-brown stony loam about 2 inches thick. The subsurface layer is grayish-brown stony loam about 3 inches thick. The subsoil is brown clay loam about 36 inches thick. The underlying material is brown loam that extends to a depth of 60 inches or more.

Permeability is slow, and the available water capacity is high. The surface and subsurface layers are slightly acid, and the subsoil and underlying material are neutral. The root zone extends to a depth of more than 60 inches. These soils are used for grazing, feed crops, and wood products.

Representative profile of Larkson stony loam, 5 to 20 percent slopes, in native forest, 1,760 feet south and 440 feet east of the northwest corner of sec. 6, T. 25 S., R. 67 W.

O1—1 inch to 0, organic mat of needles, twigs, and pine cones.

A1—0 to 2 inches, dark grayish-brown (10YR 4/2) stony loam, very dark brown (10YR 2/2) when moist; weak, thin, platy structure parting to weak, fine, granular; soft, very friable; nonsticky and slightly plastic; neutral; clear, smooth boundary.

A2—2 to 5 inches, grayish-brown (10YR 5/2) stony loam, very dark grayish brown (10YR 3/2) when moist; very weak, medium and fine, subangular blocky structure; slightly hard, very friable; nonsticky and slightly plastic; slightly acid; clear, smooth boundary.

B&A—5 to 8 inches, variegated brown (10YR 4/3) and light brownish-gray (10YR 6/2) clay loam, very dark grayish brown (10YR 3/3) and dark brown (10YR 3/2) when moist; weak, medium, prismatic structure parting to weak, medium, subangular blocky; hard, friable; slightly sticky and plastic; thin, patchy, clay films on peds; neutral; clear, smooth boundary.

B21t—8 to 18 inches, brown (7.5YR 5/4) heavy clay loam, dark brown (7.5YR 4/4) when moist; moderate, medium and fine, prismatic structure parting to moderate to strong, medium and fine, subangular blocky; very hard, firm; slightly sticky and plastic; thin, continuous, clay films on peds; neutral; clear, smooth boundary.

B22t—18 to 30 inches, brown (7.5YR 5/4) heavy clay loam, dark brown (7.5YR 4/4) when moist; moderate, medium, prismatic structure parting to moderate, medium, subangular blocky; very hard, firm; slightly sticky and plastic; thin, nearly continuous, clay films on peds; neutral; clear, smooth boundary.

B3—30 to 41 inches, brown (7.5YR 5/4) light clay loam, dark brown (7.5YR 4/4) when moist; weak, coarse, prismatic structure parting to weak, coarse, subangular

blocky; hard, friable; slightly sticky and plastic; thin, patchy, clay films on vertical faces of peds; neutral; clear, smooth boundary.

C—41 to 60 inches, brown (7.5YR 5/4) loam, dark brown (7.5YR 4/4) when moist; massive; slightly hard, friable; nonsticky and slightly plastic; neutral.

The O horizon ranges from less than 1 inch to 3 inches in thickness. The A1 horizon ranges from very dark grayish brown to very dark brown and is as much as 6 inches thick. The A2 horizon ranges from sandy loam to loam but is generally light loam. It is 3 to 6 inches thick.

The B&A horizon is mostly material from the B2 horizon. It is 2 to 5 inches thick. The B21t horizon is light clay to heavy clay loam 6 to 14 inches thick. It ranges from brown to dark brown, mainly in hue of 7.5YR. The B22t horizon is brown to dark-brown light clay to heavy clay loam 9 to 14 inches thick. The B3 horizon is loam to light clay loam 8 to 12 inches thick. It ranges from brown to dark brown, mainly in hue of 7.5YR.

Depth to the C horizon ranges from 35 to 45 inches. The C horizon is loam to gravelly sandy loam. In places it is underlain by cobbly granitic gravelly sand or by granite rock at a depth of 40 to 80 inches.

LbD—Larkson loam, 6 to 12 percent slopes. This soil is on loess-thickened, east-facing dip slopes of sandstone upland plains in the western part of the survey area. The areas are irregular in shape and cover as much as 700 acres. This soil has a profile similar to the one described as representative of the series, but there are no stones in the surface layer and no cobbles and gravel in the substratum. Also, in places, the surface layer is as much as 7 inches thick, especially in spaces between trees where the grass is more dense.

Included with this soil in mapping are areas of Vamer soils and Rock outcrop that make up about 10 percent of the acreage and areas of Holderness silt loam that make up about 5 percent.

Runoff is medium, and the hazard of erosion is moderate.

This soil has high potential for timber, recreation, and wildlife habitat. The native vegetation is ponderosa pine. Capability unit IVe–3, nonirrigated; woodland group 5r1; range site not assigned.

LcE—Larkson stony loam, 5 to 20 percent slopes. This soil is in the western part of the survey area. The areas are irregular in shape and cover as much as 1,000 acres. This soil has the profile described as representative of the series, but on alluvial fans at the foot of mountains cobbly or gravelly sandy loam is below a depth of 40 inches, and on some mountainsides granite bedrock is at a depth of 4 to 6 feet or more. Clusters of stones and boulders cover about 3 percent of the surface.

Included with this soil in mapping, and making up about 15 percent of the acreage, are areas of Larkson extremely stony loam and Larkson gravelly sand on the sides of small ravines. Also included are areas of Holderness soils that make up about 5 percent.

Runoff is medium, and the hazard of erosion is high.

This soil has potential for recreation, wildlife habitat, and timber. The native vegetation is ponderosa pine. Capability unit VIe–5, nonirrigated; woodland group 5r1; not in a range site.

Las Animas Series

The Las Animas series consists of deep, somewhat poorly drained soils. These soils formed on bottom lands in loamy alluvium. The slope is 0 to 2 percent, and elevation is 4,300 to 4,900 feet. The average annual precipitation is 12 inches. The average annual temperature is 53° F, and the frost-free season is 155 to 165 days. The native vegetation is salt-tolerant grasses and woody plants.

In a representative profile the surface layer, about 6 inches thick, is very pale brown fine sandy loam that has yellowish-brown mottles. The subsurface layer, about 12 inches thick, is very pale brown stratified fine sand and fine sandy loam that has dark yellowish-brown and gray mottles. The underlying material is about 23 inches of light brownish-gray fine sandy loam that has dark-gray mottles over dark-gray stratified silty clay loam and fine sandy loam that extends to a depth of 60 inches or more.

Permeability is moderately rapid, and the available water capacity is high. These soils are moderately alkaline to strongly alkaline. Their root zone extends to a depth of 60 inches or more. Most of these soils are used for grazing. About 20 percent is used for irrigated feed crops.

Representative profile of Las Animas fine sandy loam, in grass on an oxbow of the Arkansas River, about 700 feet west of the southeast corner of sec. 30, T. 21 S., R. 60 W.

A1—0 to 6 inches, very pale brown (10YR 7/3) fine sandy loam, brown (10YR 5/3) and has common, medium, yellowish-brown (10YR 5/6) mottles when moist; weak, medium, granular structure; slightly hard, very friable; nonsticky and slightly plastic; calcareous; moderately alkaline; clear, smooth boundary.

AC—6 to 18 inches, very pale brown (10YR 7/3) fine sandy loam, brown (10YR 5/3) and has common, medium, distinct, gray (10YR 5/1) and dark yellowish-brown (10YR 4/4) mottles when moist; weak, medium, subangular blocky structure; slightly hard, very friable; nonsticky and slightly plastic; calcareous; moderately alkaline; clear, smooth boundary.

C1g—18 to 41 inches, light brownish-gray (10YR 6/2) fine sandy loam, dark grayish brown (10YR 4/2) and has common, large, faint, dark-gray (10YR 4/1) mottles when moist; massive; slightly hard, very friable; nonsticky and slightly plastic; calcareous; moderately alkaline; clear, gradual boundary.

C2g—41 to 60 inches, dark-gray (N 4/0) when moist stratified silty clay loam and fine sandy loam; massive; very friable sticky and slightly plastic; strongly calcareous; moderately alkaline.

These soils are highly stratified but are mostly fine sandy loam. The A horizon ranges from 3 to 12 inches thick. The AC and C horizons range from moderately alkaline to strongly alkaline. In places as much as 5 percent of the AC horizon is gypsum in the form of small crystalline masses. Depth to the Cg horizon ranges from 6 to 30 inches.

Lm—Las Animas fine sandy loam. This soil is on bottom lands of rivers and creeks. The areas cover as much as 500 acres.

Included with this soil in mapping are areas of Bankard sand and water-deposited sand, gravel, and cobbles that make up about 20 percent of the acreage. Also included are areas of Apishapa silty clay in narrow, shallow, meandering channels. These areas make up about 5 percent of the acreage.

Runoff is slow, and the hazard of water erosion is slight. The soil is subject to frequent, brief flooding.

The water table is at a depth of 1.5 to 3 feet. The surface layer is low to high in content of salts.

The native vegetation is inland saltgrass, alkali sacaton, tamarisk, and willow. Capability units IIIw–2, irrigated, and VIw–1, nonirrigated; Salt Meadow range site.

Limon Series

The Limon series consists of deep, well-drained soils. These soils formed on alluvial fans and terraces in clayey alluvium. The slope is 0 to 5 percent, and elevation is 4,300 to 5,100 feet. The average annual precipitation is 12 inches. The average annual temperature is 53°F, and the frost-free season is 145 to 175 days. The native vegetation is mainly plains grasses.

In a representative profile the surface layer is grayish-brown silty clay loam about 4 inches thick. The subsurface layer is light brownish-gray silty clay about 14 inches thick. The underlying material is light brownish-gray silty clay about 17 inches thick over light brownish-gray silty clay loam that extends to a depth of 60 inches or more.

Permeability is slow, and the available water capacity is high. The surface and subsurface layers are moderately alkaline and the underlying material is moderately alkaline or strongly alkaline. The root zone extends to a depth of more than 60 inches. These soils are used for grazing and irrigated crops.

Representative profile of Limon silty clay loam, 0 to 2 percent slopes, in grass, 2.5 miles west and 0.2 mile north of the southeast corner of sec. 36, T. 25 S., R. 60 W.

A—0 to 4 inches, grayish-brown (2.5YR 5/2) silty clay loam, dark grayish brown (10YR 4/2) when moist; weak, fine and very fine, granular structure; slightly hard, firm; sticky and plastic; calcareous; moderately alkaline; abrupt, smooth boundary.

AC—4 to 18 inches, light brownish-gray (2.5Y 6/2) silty clay, dark grayish brown (2.5Y 4/2) when moist; weak, medium and fine, subangular blocky structure; hard, firm; sticky and plastic; calcareous; moderately alkaline; abrupt, smooth boundary.

C1—18 to 35 inches, light brownish-gray (2.5Y 6/2) silty clay, dark grayish brown (2.5Y 4/2) when moist; weak, fine and very fine, subangular blocky structure; hard, firm; sticky and plastic; calcareous; fine filaments and threads; crystalline gypsum; moderately alkaline; gradual, smooth boundary.

C2—35 to 60 inches, light brownish-gray (2.5Y 6/2) silty clay loam, dark grayish brown (2.5Y 4/2) when moist; massive; slightly hard, friable; sticky and plastic; strongly calcareous; moderately alkaline.

These soils range from moderately alkaline to strongly alkaline. They range from clay to silty clay loam. The AC and C horizons have weak blocky and weak platy structure or are massive.

LnA—Limon silty clay loam, 0 to 2 percent slopes. This soil is on alluvial fans and terraces in the north-central and southeastern parts of the survey area. The areas cover as much as 1,000 acres. This soil has the profile described as representative of the series.

Included with this soil in mapping are areas of Razor soils that make up about 5 percent of the acreage.

Runoff is medium. The hazard of erosion is generally moderate, but it is severe in places. Deep gullying and soil piping are hazards where the range is overgrazed. The soil generally is not subject to flooding, but long, narrow, nearly level areas along Dry Creek, Haynes Creek, and Kramer Creek and similar areas are subject to frequent, brief flooding.

This soil is difficult to till because it is cloddy when dry and sticky and plastic when wet. The native grasses are mainly galleta, blue grama, and alkali sacaton. Capability units IIe–1, irrigated, and VIe–2, nonirrigated; Salt Flats range site.

LnB—Limon silty clay loam, 2 to 5 percent slopes. This soil is in long, narrow areas between the Arkansas River and Fountain Creek. The areas cover as much as 300 acres. This soil has a profile similar to the one described as representative of the series.

Included with this soil in mapping are areas of Razor soils that make up about 20 percent of the acreage.

Runoff is rapid, and the hazard of erosion is high.

The native grasses are mainly alkali sacaton, blue grama, and galleta. Capability units IIIe–2, irrigated, and VIe–2, nonirrigated; Salt Flats range site.

LoA—Limon silty clay, 0 to 2 percent slopes. This soil is on alluvial fans and terraces in the north-central and southwestern parts of the survey area. The areas cover as much as 800 acres. This soil has a profile similar to the one described as representative of the series, but the surface layer is silty clay and the underlying material is strongly alkaline. About 15 percent of the surface area is covered by barren slickspots.

Included with this soil in mapping are areas of Apishapa and Haverson soils that make up about 10 percent each of the acreage.

Runoff is slow, and the hazard of erosion is moderate.

This soil is difficult to till because it is sticky and plastic when wet. The native vegetation is mainly alkali sacaton, blue grama, galleta, and greasewood. Capability units IIIs–1, irrigated, and VIe–2, nonirrigated; Salt Flats range site.

LvB—Limon silty clay, 0 to 5 percent slopes, gullied. This soil is in the central part of the survey area. The areas are irregularly shaped and cover as much as 600 acres. This soil has a profile similar to the one described as representative of the series, but the surface layer is silty clay and the areas are dissected by gullies that are 2 to 10 feet deep.

Included with this soil in mapping are areas of Midway soils and Shale outcrop that make up about 15 percent of the acreage.

Runoff is rapid, and the hazard of erosion is high.

Range seeding is difficult because of the deep gullies. Capability unit VIIe–1, nonirrigated; not in a range site.

Manvel Series

The Manvel series consists of deep, well-drained soils. These soils formed on alluvial fans in silty colluvial and alluvial material that weathered mainly from limestone. The slope is 0 to 5 percent, and elevation is 4,400 to 5,800 feet. The average annual precipitation is 12 inches. The average annual temperature is 53° F, and the frost-free season is 145 to 175 days. The native vegetation is mainly plains grasses.

In a representative profile the surface layer is light brownish-gray silt loam about 4 inches thick. The subsurface layer is light brownish-gray silt loam about 5 inches thick. The underlying material is very pale brown silt loam that extends to a depth of 60 inches or more.

Permeability is moderately slow, and the available water capacity is high. These soils are moderately alkaline. Their root zone extends to a depth of more than 60 inches. These soils are used for grazing and for dryland and irrigated crops.

Representative profile of Manvel silt loam, 1 to 5 percent slopes, in grass, 220 feet south and 1,100 feet west of the northeast corner of sec. 25, T. 21 S., R. 66 W.

A1—0 to 4 inches, light brownish-gray (10YR 6/2) silt loam, dark grayish brown (10YR 4/2) when moist; weak, granular structure; soft, very friable; nonsticky and slightly plastic; calcareous; moderately alkaline; clear, smooth boundary.

AC—4 to 9 inches, light brownish-gray (10YR 6/2) silt loam, dark grayish brown (10YR 4/2) when moist; weak, medium, prismatic structure; slightly hard, very friable; nonsticky and slightly plastic; calcareous; moderately alkaline; clear, smooth boundary.

C1—9 to 15 inches, very pale brown (10YR 7/3) silt loam, brown (10YR 5/3) when moist; very weak, medium, subangular blocky structure; hard, friable; nonsticky and slightly plastic; calcareous; small, rounded masses of lime; moderately alkaline; gradual, smooth boundary.

C2—15 to 60 inches, very pale brown (10YR 7/3) silt loam, brown (10YR 5/3) when moist; massive; slightly hard, very friable; nonsticky and slightly plastic; calcareous; moderately alkaline.

The A horizon ranges from loam to silty clay loam. The AC and C horizons range from silt loam to silty clay loam. The structure of the AC and C1 horizons is very weak to moderate. Hard limestone rock or soft marl is at a depth of 40 inches to several feet.

MaA—Manvel silt loam, 0 to 1 percent slopes. This soil is on terraces, mesas, and nearly level plains in the central and eastern parts of Pueblo County. The areas are irregular in shape and cover as much as 600 acres.

Included with this soil in mapping are areas of Kim fine sandy loam that are mostly on terraces of the Arkansas River. These areas make up about 15 percent of the acreage.

Runoff is slow. The hazard of erosion is slight in irrigated areas, and the hazard of soil blowing is moderate in nonirrigated areas.

This soil is well suited to irrigated corn, sorghum, small grain, alfalfa, vegetables, and grasses. The native vegetation is mainly blue grama, galleta, sand dropseed, yucca, and cactus. Capability units I, irrigated, and VIe–1, nonirrigated; Loamy Plains range site.

MaB—Manvel silt loam, 1 to 5 percent slopes. This soil makes up about 28 percent of the survey area. It occurs in all parts of the survey area, except for the wooded section and the northeastern part of Pueblo County. The slope is mostly 3 percent or less. The areas are irregular in shape and cover as much as 200 acres. This soil has the profile described as representative of the series.

Included with this soil in mapping are areas of Minnequa and Kim soils that make up about 10 percent each of the acreage. The Kim soils are mostly on side slopes below limestone escarpments.

Runoff is moderate, and the hazard of erosion is moderate.

This soil is well suited to grazing. The native vegetation is mainly blue grama, galleta, western wheatgrass, and winterfat. Capability units IIIe–2, irrigated, and VIe–1, nonirrigated; Loamy Plains range site.

Mg—Manvel silt loam, gullied. This soil is mostly in the central part of Pueblo County. The areas are long and narrow and cover as much as 80 acres. They are dissected by deep gullies that have short, shallow, branching gullies.

Included with this soil in mapping are areas of Shingle soils that make up about 20 percent of the acreage.

Runoff is moderate, and the hazard of erosion is moderate.

Gully erosion makes range seeding difficult. Capability unit VIIe–1, nonirrigated; not in a range site.

Mn—Manvel silt loam, wet. This is a moderately well drained, loamy soil. The slope is mostly 0 to 1 percent. The areas cover as much as 700 acres. This soil has a profile similar to the one described as representative of the series, but it is saturated with water below a depth of 55 inches. It also has a low to high concentration of salts at the surface and small threads and seams of salts in the upper 16 inches.

Included with this soil in mapping are areas of Minnequa soils. These areas have water perched on the underlying bedrock that is within a depth of 40 inches. They make up about 5 percent of the acreage.

This soil is used mostly for pasture. The native vegetation is mainly alkali sacaton, inland saltgrass, and kochia. Capability unit VIw–1, nonirrigated; Salt Meadow range site.

Manzanola Series

The Manzanola series consists of deep, well-drained soils. These soils formed on terraces and alluvial fans in clayey alluvium that was derived from sedimentary rock. The slope is 0 to 9 percent, and elevation is 4,300 to 5,800 feet. The average annual precipitation is 12 inches. The average annual temperature is 53° F, and the frost-free season is 145 to 175 days. The native vegetation is mainly plains grasses.

In a representative profile the surface layer is light brownish-gray silty clay loam about 4 inches thick. The upper part of the subsoil is grayish-brown and pale-brown heavy clay loam about 16 inches thick, and the lower part is pale-brown silty clay loam about 14 inches thick. The underlying material is pale-brown clay loam that extends to a depth of 60 inches or more.

Permeability is slow, and the available water capacity is high. The surface layer and subsoil are moderately alkaline, and the underlying material is moderately alkaline or strongly alkaline. The root zone extends to a depth of more than 60 inches. These soils are used for grazing.

Representative profile of Manzanola silty clay loam, 0 to 2 percent slopes, in grass, 0.25 mile east and 100 feet south of the center of sec. 17, T. 22 S., R. 63 W.

A—0 to 4 inches, light brownish-gray (10YR 6/2) silty clay loam, dark brown (10YR 4/3) when moist; weak, very thin, platy structure parting to weak, fine, granular; soft, very friable; slightly sticky and slightly plastic; calcareous; moderately alkaline; abrupt, smooth boundary.

B21t—4 to 11 inches, grayish-brown (10YR 5/2) heavy clay loam, dark brown (10YR 4/3) when moist; moderate, medium and fine, subangular blocky structure; slightly hard, friable; sticky and plastic; thin, patchy, clay films on peds; calcareous; moderately alkaline; clear, smooth boundary.

B22t—11 to 20 inches, pale-brown (10YR 6/3) heavy clay loam, brown (10YR 5/3) when moist; moderate, medium and fine, subangular blocky structure; hard, firm; sticky and plastic; thin, very patchy, clay films on peds; calcareous; moderately alkaline; clear, smooth boundary.

B3—20 to 34 inches, pale-brown (10YR 6/3) silty clay loam, brown (10YR 5/3) when moist; weak, coarse, subangular blocky structure parting to weak, medium and fine, subangular blocky, hard, firm; sticky and plastic; calcareous; few, fine, rounded masses of crystalline gypsum; moderately alkaline; clear, smooth boundary.

Ccs—34 to 60 inches, pale-brown (10YR 6/3) clay loam, brown (10YR 5/3) when moist; massive; slightly hard, firm; sticky and plastic; calcareous; few, fine, rounded masses of crystalline gypsum; moderately alkaline.

The A horizon is silt loam to clay loam 3 to 8 inches thick. The B2t horizon ranges from clay to silty clay loam 12 to 32 inches thick. The lower part of the B horizon ranges from moderately alkaline to strongly alkaline. Some profiles are as much as 15 percent gravel.

MoD—Manzanola clay loam, 2 to 9 percent slopes. This soil is on colluvial slopes below escarpments of limestone or shale in the western part of the survey area and at the foot of mesas in the northeastern part. The areas cover as much as 400 acres. This soil has a profile similar to the one described as representative of the series, but the surface layer is grayish brown, and the subsoil is very plastic. Also, in the northeastern part of the survey area the surface layer and upper part of the subsoil are as much as 15 percent gravel.

Included with this soil in mapping are areas of Manvel silt loam that make up about 15 percent of the acreage.

Runoff is moderate, and the hazard of erosion is moderate.

This soil is well suited to grazing. The native vegetation is mainly western wheatgrass, blue grama, and fourwing saltbush. The potential for improving the range cover is good. Capability unit VIe–1, nonirrigated; Loamy Plains range site.

MpA—Manzanola silty clay loam, 0 to 2 percent slopes. This soil is on deeply dissected fans and terraces. The areas are irregular in shape and cover as much as 300 acres. This soil has the profile described as representative of the series.

Included with this soil in mapping are areas of Haverson silt loam and Haverson fine sandy loam that make up as much as 15 percent of the acreage.

Runoff is slow, and the hazard of erosion is moderate. Gully headcutting is a hazard. The soil is subject to rare or occasional brief flooding received as runoff from adjacent higher areas.

This soil is well suited to grazing. The native vegetation is mainly fourwing saltbush, western wheatgrass, blue grama, and galleta. The potential for improving the range cover is good. Capability unit VIw–2, nonirrigated; Saline Overflow range site.

Midway Series

The Midway series consists of shallow, well-drained soils. These soils formed on uplands in clayey residuum that was derived mostly from shale. They are underlain by soft shale at a depth of 8 to 20 inches. The slope is 1 to 9 percent, and elevation is 4,400 to 5,800 feet. The average annual precipitation is 12 inches. The average annual temperature is 53° F, and the frost-free season is 145 to 175 days. The native vegetation is mainly plains grasses.

In a representative profile the surface layer is grayish-brown silty clay about 2 inches thick. The underlying material is light brownish-gray silty clay about 7 inches thick. Soft shale is a depth of about 9 inches.

Permeability is slow, and the available water capacity is very low. These soils are moderately alkaline to strongly alkaline. Their root zone extends to a depth of 9 to 20 inches. They are used for grazing.

Representative profile of Midway silty clay, in an area of Midway-Shale outcrop complex, 1 to 9 percent slopes, in grass, 0.45 mile east and 0.15 mile south of the northwest corner of sec. 26, T. 26 S., R. 60 W.

A—0 to 2 inches, grayish-brown (2.5Y 5/2) silty clay, dark grayish brown (2.5Y 4/2) when moist; moderate, very fine, granular structure; soft, friable; sticky and plastic; moderately alkaline; abrupt, smooth boundary.

C1—2 to 9 inches, light brownish-gray (2.5Y 6/2) silty clay, olive brown (2.5Y 4/4) when moist; massive; slightly hard, firm; sticky and plastic; calcareous; moderately alkaline; abrupt, smooth boundary.

C2—9 inches, calcareous, soft shale.

The soil ranges from clay to silty clay loam. Depth to shale ranges from 8 to 20 inches.

MsD—Midway-Shale outcrop complex, 1 to 9 percent slopes. This complex is in all but the forested parts of the survey area. It is made up of about 50 percent Midway silty clay and 40 percent Shale outcrop. Areas of this complex are irregular in shape and cover as much as 40 acres.

The Midway soil in this complex has the profile described as representative of the Midway series.

Included with these soils in mapping are areas of Razor clay loam that make up about 10 percent of the acreage.

Runoff is rapid, and the hazard of erosion is high.

This Midway soil is better suited to grazing than to other uses. The native grass is mainly galleta, but alkali sacaton, western wheatgrass, and blue grama are common. In places the shale contains the mineral selenium, which is absorbed by some native plants. These plants are poisonous and, if eaten in large quantities, are harmful to livestock. Capability unit VIIs–1, nonirrigated; Shaly Plains range site.

Minnequa Series

The Minnequa series consists of moderately deep, well-drained soils. These soils formed on uplands in silty residuum weathered from limestone. The slope is 1 to 3 percent, and elevation is 4,400 to 5,800 feet.

The average annual precipitation is 12 inches. The average annual temperature is 53°F, and the frost-free season is 145 to 175 days. The native vegetation is mainly plains grasses.

In a representative profile (fig. 4) the surface layer is light-gray loam about 4 inches thick. The subsurface layer is very pale brown loam about 6 inches thick. The underlying layer is very pale brown silt loam about 22 inches thick. Below that is very pale brown limestone.

Permeability and the available water capacity are moderate. These soils are moderately alkaline. Their root zone extends to a depth of 20 to 40 inches. These soils are used for grazing.

Representative profile of Minnequa loam, in an area of Minnequa-Manvel loams, in grass, about 0.35 mile east and 0.2 mile north of the southwest corner of sec. 27, T. 19 S., R. 67 W.

A—0 to 4 inches, light-gray (10YR 7/2) loam, brown (10YR 5/3) when moist; weak, thin, platy structure parting to weak, fine, granular; soft, friable; nonsticky and slightly plastic; calcareous; moderately alkaline; abrupt, smooth boundary.

AC—4 to 10 inches, very pale brown (10YR 7/3) loam, brown (10YR 5/3) when moist; weak, fine, granular structure; slightly hard, friable; nonsticky and slightly plastic; calcareous; moderately alkaline; clear, smooth boundary.

C1—10 to 32 inches, very pale brown (10YR 7/3) silt loam, brown (10YR 5/3) when moist; massive; slightly hard, friable; slightly sticky and slightly plastic; calcareous; moderately alkaline; clear, smooth boundary.

C2—32 inches, very pale brown (10YR 8/3) soft limestone.

The A horizon is loam or silty clay loam 3 to 6 inches thick. The AC horizon is loam or silty clay loam 4 to 10 inches thick. The C horizon is silt loam or light silty clay loam. Depth to soft limestone ranges from 20 to 40 inches. Small fragments of limestone make up less than 10 percent of the soil.

Figure 4.—Profile of Minnequa loam. Depth to soft limestone ranges from 20 to 40 inches.

Mv—Minnequa-Manvel loams. This complex is in the northwestern part of Pueblo County. It is made up of about 50 percent Minnequa loam and 40 percent Manvel loam. The slope is 1 to 3 percent. Areas of this complex are irregular in shape and cover as much as 1,000 acres.

The Minnequa soil in this complex has the profile described as representative of the Minnequa series. The Manvel soil has a profile similar to the one described as representative of the Manvel series, but the surface layer is loam and bedrock is generally at a depth of less than 6 feet.

Included with these soils in mapping are areas of Penrose soils that make up about 10 percent of the acreage.

Runoff is medium, and the hazard of erosion is moderate.

These soils are better suited to grazing than to other uses. The native grasses are mainly blue grama and galleta. Burrograss has invaded in overgrazed areas. Capability unit VIe–1, nonirrigated; Loamy Plains range site.

Mortenson Series

The Mortenson series consists of deep, well-drained soils. These soils formed on mountain uplands in residuum weathered from and colluvium that derived from sandstone and granite. The slope is 25 to 65 percent, and elevation is 6,500 to 7,600 feet. The average annual precipitation is 20 inches. The average annual temperature is 45° F, and the frost-free season is 110 to 120 days. The native vegetation is mainly mixed conifers.

In a representative profile the surface layer is grayish-brown very stony fine sandy loam about 3 inches thick. The subsurface layer is very pale brown very stony fine sandy loam about 27 inches thick. The upper part of the subsoil is very pale brown very stony light clay loam about 8 inches thick, and the lower part is yellowish-brown very stony clay that extends to a depth of 60 inches or more.

Permeability is slow, and the available water capacity is high. The surface layer is neutral, and the sub-

surface layer is moderately acid. The root zone extends to a depth of more than 60 inches. These soils are used for forestry and grazing.

Representative profile of Mortenson very stony fine sandy loam, in an area of Wetmore-Mortenson association, in woodland, in the southeast quarter of sec. 1, T. 24 S., R. 68 W.

O1—2 inches to 0, needles, leaves, and twigs.

A1—0 to 3 inches, grayish-brown (10YR 5/2) very stony sandy loam, very dark grayish brown (10YR 3/2) when moist; weak, fine, granular structure; soft, very friable; nonsticky and slightly plastic; common very fine, fine, and medium roots, 30 percent angular sandstone gravel and stones; neutral; clear, smooth boundary.

A2—3 to 30 inches, very pale brown (10YR 7/3) very stony fine sandy loam, brown (10YR 5/3) when moist; weak, fine, granular structure; soft, very friable; nonsticky and slightly plastic; common very fine, fine, and medium roots; 30 percent angular sandstone gravel and stones; medium acid; gradual, smooth boundary.

B&A—30 to 38 inches, very pale brown (10YR 7/3) very stony light clay loam, brown (10YR 5/3) when moist; moderate, fine, angular blocky structure; hard, firm; slightly sticky and slightly plastic; common very fine, fine, and medium roots; thick coatings or fingers of sand and silt grains on and between peds; 30 percent angular sandstone gravel and stones; medium acid; clear, irregular boundary.

B2t—38 to 60 inches, yellowish-brown (10YR 5/4) very stony light clay, dark yellowish brown (10YR 4/4) when moist; strong, fine, angular blocky structure; extremely hard, very firm; sticky and very plastic; continuous clay films on peds; few very fine, fine, and medium roots; 60 percent angular sandstone gravel and stones; slightly acid.

Stones and gravel make up 35 to 70 percent of the soil material. The A1 horizon is as much as 5 inches thick. Depth to the B2t horizon ranges from 24 to 40 inches. Mortenson soils are in a semiarid climatic zone, but their northerly exposure has the effect of creating a more humid microclimate.

In the Pueblo Area, Mortenson soils are mapped only with Wetmore soils.

Nederland Series

The Nederland series consists of deep, well-drained soils. These soils formed on terraces and fans in gravelly alluvial and colluvial material. The slope is 9 to 25 percent, and elevation is 5,800 to 6,700 feet. The average annual precipitation is 16 inches. The average annual temperature is 50° F, and the frost-free season is 115 to 145 days. The native vegetation is mainly grasses and shrubs of the foothills.

In a representative profile the surface layer is brown stony sandy loam about 8 inches thick. The upper part of the subsoil is light reddish-brown heavy gravelly sandy loam about 18 inches thick, and the lower part is light-brown very gravelly loamy sand about 12 inches thick. The underlying material is light-brown very gravelly sand that extends to a depth of 60 inches or more.

Permeability is moderate, and the available water capacity is low. These soils are neutral. Their root zone extends to a depth of 60 inches or more. They are used for grazing and are a source of gravel.

Representative profile of Nederland stony sandy loam, 9 to 25 percent slopes, in grass, 0.4 mile west of the northeast corner of sec. 12, T. 21 S., R. 69 W.

A1—0 to 8 inches, brown (7.5YR 5/2) stony sandy loam, very dark brown (7.5YR 3/2) when moist; weak, medium, platy structure parting to moderate, medium, fine, and very fine, granular; slightly hard, very friable; nonsticky and nonplastic; 20 percent gravel, cobbles, and stone; neutral; clear, smooth boundary.

B2t—8 to 26 inches, light reddish-brown (5YR 6/4) heavy gravelly sandy loam, reddish brown (5YR 4/3) when moist; moderate, medium, angular blocky structure; very hard, very friable; nonsticky and slightly plastic; thin, patchy, clay films on many peds and bridging sand grains; 20 percent gravel and cobbles; neutral; clear, wavy boundary.

B3—26 to 38 inches, light-brown (7.5YR 6/4) very gravelly loamy sand, dark brown (7.5YR 4/4) when moist; weak, coarse, subangular blocky structure; very hard, very friable; nonsticky and nonplastic; few, patchy, clay films on peds and bridging sand grains; 60 percent gravel and cobbles; neutral; clear, irregular boundary.

C—38 to 60 inches, light-brown (7.5YR 6/4) very gravelly sand, dark brown (7.5YR 4/4) when moist; single grained; hard; loose; nonplastic and nonsticky; 80 percent gravel and cobbles; neutral.

The A horizon ranges from 7 to 12 inches thick. The B2t horizon is gravelly sandy clay loam to heavy gravelly sandy loam 3 to 37 inches thick. The sand is medium and coarse angular granitic. Coarse fragments that are more than 3 inches in diameter make up 15 to 40 percent of the coarse-textured material. In places there are black stains on the cobbles in the C horizon.

NdE—Nederland stony sandy loam, 9 to 25 percent slopes. This soil is in the foothills on ridges and steep side slopes at the edge of terraces in the western part of the survey area. The areas are long and narrow and cover as much as 400 acres.

Included with this soil in mapping are areas of Nunn stony loam that make up about 15 percent of the acreage.

Runoff is rapid, and the hazard of erosion is high.

This soil is a good source of gravel. The soil is used for grazing, but the steep slopes, stoniness, and low available water capacity reduce its usefulness and limit the potential for improvement of range vegetation. The native grasses are mainly Scribner needlegrass, pinon ricegrass, indian ricegrass, side-oats grama, and little bluestem. Capability unit VIIs–3, nonirrigated; Cobbly Foothills range site.

Neville Series

The Neville series consists of deep, well-drained soils. These soils formed on fans and uplands in loamy alluvium and colluvium that derived from red sandstone. The slope is 3 to 9 percent, and elevation is 5,700 to 6,500 feet. The average annual precipitation is 13 inches. The average annual temperature is 49° F, and the frost-free season is 130 to 160 days. The native vegetation is grasses of the foothills.

In a representative profile the surface layer is reddish-brown sandy loam about 4 inches thick. The subsurface layer is reddish-brown sandy clay loam about 5 inches thick. The underlying material is pink loam about 35 inches thick over light-red loam that extends to a depth of 60 inches or more. Small filaments and threads of lime occur in the underlying material.

Permeability is moderate, and the available water capacity is high. The surface layer is neutral, and the subsurface layer and the underlying material are moderately alkaline. The root zone extends to a depth of more than 60 inches.

These soils are a part of the Fort Carson training grounds and are also used for grazing.

Representative profile of Neville sandy loam, 3 to 9 percent slopes, in grass, 0.3 mile south and 0.15 mile east of the northwest corner of sec. 3, T. 18 S., R. 67 W.

A1—0 to 4 inches, reddish-brown (5YR 5/3) sandy loam, weak red (2.5YR 4/2) when moist; weak, medium, granular structure; soft, very friable; nonsticky and slightly plastic; mildly alkaline; clear, smooth boundary.

AC—4 to 9 inches, reddish-brown (5YR 5/4) sandy clay loam, reddish brown (2.5YR 4/4) when moist; moderate, medium, subangular blocky structure; hard, very friable; slightly sticky and slightly plastic; mildly alkaline; gradual, smooth boundary.

C1—9 to 44 inches, pink (5YR 7/4) loam, reddish brown (2.5YR 5/4) when moist; weak, coarse, prismatic structure parting to moderate, medium, subangular blocky; hard, very friable; slightly sticky and slightly plastic; calcareous; few small filaments and threads of lime; moderately alkaline; gradual, smooth boundary.

C2—44 to 60 inches, light-red (2.5YR 6/6) loam, reddish brown (2.5YR 4/4) when moist; weak, fine, subangular blocky structure; slightly hard, very friable; slightly sticky and slightly plastic; calcareous; moderately alkaline.

The A and AC horizons are sandy loam or sandy clay loam 4 to 6 inches thick. The C horizon is light sandy clay loam, loam, or silt loam. In places it has layers of fine sandy loam as much as 15 inches thick.

NeD—Neville sandy loam, 3 to 9 percent slopes. This soil is in the northwestern part of the survey area along the El Paso-Pueblo County line. It is mostly in one large area that covers about 1,600 acres.

Included with this soil in mapping, and making up about 5 percent of the acreage, are nearly level areas of Nunn clay loam along small drainageways.

Runoff is medium, and the hazard of erosion is moderate.

This soil is best suited to grazing. The native vegetation is mainly needlegrass, blue grama, and yucca. Capability unit VIe–3, nonirrigated; Sandy Foothills range site.

Nunn Series

The Nunn series consists of deep, well-drained soils. These soils formed on uplands in loess and loamy residuum weathered from sandstone. The slope is 0 to 9 percent, and elevation is 5,800 to 6,700 feet. The average annual precipitation is 16 inches. The average annual temperature is 50° F, and the frost-free season is 115 to 145 days. The native vegetation is mainly grasses of the foothills.

In a representative profile the surface layer is grayish-brown clay loam about 6 inches thick. The subsoil is brown and pale-brown clay loam and heavy clay loam about 26 inches thick. The underlying material is pale-brown loam that extends to a depth of 60 inches or more.

Permeability is slow, and the available water capacity is high. The surface layer is mildly alkaline, and the underlying material is moderately alkaline. The root zone extends to a depth of 60 inches or more. These soils are used for grazing and for dryland crops.

Representative profile of Nunn clay loam, 0 to 5 percent slopes, in native grass, 100 feet east and 0.4 mile north of the southwest corner of sec. 27, T. 22 S., R. 67 W.

A1—0 to 6 inches, grayish-brown (10YR 5/2) clay loam, very dark grayish brown (10YR 3/2) when moist; weak, fine, granular structure; slightly hard, very friable; slightly sticky and plastic; neutral; clear, smooth boundary.

B1—6 to 9 inches, brown (10YR 5/3) clay loam, dark brown (10YR 3/3) when moist; moderate, fine, subangular blocky structure; slightly hard, friable; sticky and plastic; thin, patchy, clay films on vertical faces of peds; neutral; clear, smooth boundary.

B21t—9 to 16 inches, brown (10YR 5/3) heavy clay loam, dark brown (10YR 3/3) when moist; moderate, medium, prismatic structure parting to strong, medium, subangular blocky; very hard, firm; sticky and plastic; continuous, clay films on peds; mildly alkaline; clear, smooth boundary.

B22t—16 to 23 inches, brown (10YR 5/3) heavy clay loam, dark brown (10YR 4/3) when moist; moderate, medium, prismatic structure parting to moderate, medium, subangular blocky; very hard, firm; sticky and plastic; thin, nearly continuous, clay films on peds; mildly alkaline; clear, smooth boundary.

B3ca—23 to 32 inches, pale-brown (10YR 6/3) clay loam, dark brown (10YR 4/3) when moist; weak, coarse, subangular blocky structure; hard, friable; sticky and plastic; calcareous; common fine and medium filaments and soft masses of lime; moderately alkaline; clear, smooth boundary.

C—32 to 60 inches, pale-brown (10YR 6/3) loam, dark brown (10YR 4/3) when moist; weak, coarse, prismatic structure; slightly hard, very friable; slightly sticky and slightly plastic; strongly calcareous; common fine and medium filaments and soft masses of lime; moderately alkaline.

The A1 horizon is loam, stony loam, or clay loam 6 to 9 inches thick. The B horizon is 18 to 34 inches thick. Cracks that are one-fourth inch wide extend from the surface into the B horizon in places where the soil dries out. Sandstone is at a depth of 4 feet or more.

NnD—Nunn stony loam, 3 to 9 percent slopes. This soil is in the foothills in the southwestern part of Pueblo County and the northeastern part of Custer County. The areas are irregularly shaped and cover as much as 200 acres. This soil has a profile similar to the one described as representative of the series, but unevenly scattered stones cover as much as 3 percent of the surface.

Included with this soil in mapping are areas of Nederland stony loam and Denver clay loam that make up about 5 percent each of the acreage. Also included are a few small slickpots.

This soil has high potential for wildlife use if the habitat can be improved. Stones make tillage difficult, but the soil can be used for hay or improved pasture. The native vegetation is mainly western wheatgrass, blue grama, junegrass, and side-oats grama. Capability unit IVe–3, nonirrigated; Loamy Foothills range site.

NuC—Nunn clay loam, 0 to 5 percent slopes. This soil is in the western part of Pueblo County and the northeastern part of Custer County. The areas are irregularly shaped and cover as much as 600 acres. This soil has the profile described as representative of the series.

Included with this soil in mapping are small areas of Wormser silt loam that make up about 10 percent of the acreage.

Runoff is medium, and the hazard of erosion is slight.

This soil is suited to dryland crops and grazing. It has high potential for wildlife use if the habitat can be improved. The native vegetation is mainly western wheatgrass and blue grama. Capability unit IIIe–1, nonirrigated; Loamy Foothills range site.

NuD—Nunn clay loam, 5 to 9 percent slopes. This soil is in the western part of Pueblo County and the northeastern part of Custer County. Areas are irregular in shape and cover as much as 200 acres. This soil has a profile similar to the one described as representative of the series.

Included with this soil in mapping are areas of Travessilla soils that make up about 5 percent of the acreage.

Runoff is medium, and the hazard of erosion is slight.

This soil is used mostly for grazing. It is also used for dryland wheat and grain sorghum. It has high potential for wildlife use if the habitat can be improved. The native vegetation is mainly western wheatgrass and blue grama. Capability unit IVe–3, nonirrigated; Loamy Foothills range site.

Olney Series

The Olney series consists of deep, well-drained soils. These soils formed on high terraces in wind-sorted alluvium. The slope is 0 to 3 percent, and elevation is 4,400 to 5,200 feet. The average annual precipitation is 12 inches. The average annual temperature is 52° F, and the frost-free season is 130 to 160 days. The native vegetation is mainly short plains grasses.

In a representative profile the surface layer is light brownish-gray sandy loam about 8 inches thick. The upper part of the subsoil is brown sandy clay loam about 8 inches thick, and the lower part is very pale brown sandy loam about 6 inches thick. The underlying material is very pale brown sandy loam about 24 inches thick. Below that it is very pale brown fine sandy loam that extends to a depth of 60 inches or more.

Permeability is moderate, and the available water capacity is high. The surface layer is neutral, and the underlying material is moderately alkaline. The root zone extends to a depth of more than 60 inches. These soils are used for grazing and dryland crops.

Representative profile of Olney sandy loam, in grass, 327 feet east of the southwest corner of sec. 27, T. 20 S., R. 60 W.

A—0 to 8 inches, light brownish-gray (10YR 6/2) sandy loam, dark grayish brown (10YR 4/2) when moist; weak, coarse, prismatic structure parting to weak, fine, granular; soft, very friable; nonsticky and slightly plastic; neutral; clear, smooth boundary.

B2t—8 to 16 inches, brown (10YR 5/3) sandy clay loam, dark brown (10YR 3/3) when moist; moderate, medium and coarse, prismatic structure parting to moderate, medium and fine, subangular blocky; hard, friable; slightly sticky and plastic; thin, patchy, clay films on peds; mildly alkaline; clear, smooth boundary.

B3ca—16 to 22 inches, very pale brown (10YR 7/3) sandy loam, pale brown (10YR 6/3) when moist; weak, coarse, prismatic structure parting to weak, medium, subangular blocky; slightly hard, friable; slightly sticky and slightly plastic; calcareous; common small masses of lime; moderately alkaline; clear, smooth boundary.

C1ca—22 to 46 inches, very pale brown (10YR 7/3) sandy loam, brown (10YR 5/3) when moist; massive; soft, very friable; nonsticky and nonplastic; calcareous; common large masses of lime; moderately alkaline; clear, smooth boundary.

C2—46 to 60 inches, very pale brown (10YR 7/3) sandy loam, brown (10YR 5/3) when moist; massive; soft, very friable; nonsticky and nonplastic; calcareous; moderately alkaline.

The A horizon is loamy sand or sandy loam 5 to 18 inches thick. The B2t horizon is 8 to 18 inches thick. The C2 horizon is loam, fine sandy loam, sandy loam, or loamy fine sand.

Oe—Olney loamy sand. This soil is in the northeastern part of Pueblo County. The areas cover as much as 600 acres. This soil has a profile similar to the one described as representative of the series, but the surface layer is loamy sand 6 to 18 inches thick. The surface layer is thinner in cultivated areas and thicker in range areas because wind has removed the finer soil particles from cultivated land and deposited them in places as small drifts on and around the edges of fields. In places the present plow layer is a mixture of the original surface layer of loamy sand and patches of material from the subsoil.

Included with this soil in mapping are areas of Vona loamy sand that make up about 15 percent of the acreage and areas of Vona and Otero soils that make up about 5 percent. Small, round, light-colored spots of Vona and Otero soils are generally on small knolls in fields.

Runoff is slow, and the hazard of soil blowing is high.

This soil is better suited to grazing than to other uses. The potential is high for wildlife use if the habitat can be improved. The native vegetation is mainly blue grama, sand dropseed, and sand sage. Capability unit IVe–2, nonirrigated; Sandy Plains range site.

Of—Olney sandy loam. This soil is in the northeastern part of Pueblo County. The slope is mostly 0 to 2 percent. The areas are irregularly shaped and cover as much as 600 acres. This soil has the profile described as representative of the series, but in cultivated fields the plow layer is a mixture of the original surface layer and material from the subsoil.

Included with this soil in mapping, and making up about 5 percent of the acreage, are areas of Vona and Otero soils. These included soils occur as light-colored, rounded spots in cultivated fields.

Runoff is slow, and the hazard of soil blowing is high.

This soil is better suited to grazing than to other uses. In years of average or above average rainfall in dry farmed areas, pinto beans and grain sorghum commonly grew well. The potential is high for wildlife use if the habitat can be improved. The native vegetation is mainly blue grama. Capability unit IVe–2, nonirrigated; Sandy Plains range site.

Otero Series

The Otero series consists of deep, well-drained soils. These soils formed on terraces in wind-sorted alluvium. The slope is 0 to 9 percent, and elevation is 4,400 to 5,200 feet. The average annual precipitation is 12 inches. The average annual temperature is 53° F, and the frost-free season is 145 to 175 days. The native vegetation is mainly short plains grasses.

In a representative profile the surface layer is light brownish-gray sandy loam about 4 inches thick. The subsurface layer is light brownish-gray sandy loam about 8 inches thick. The underlying material is very pale brown sandy loam and fine sandy loam that extends to a depth of 60 inches or more.

Permeability is rapid, and the available water capacity is moderate. The surface layer is mildly alkaline, and the subsurface layer and underlying material are moderately alkaline. The root zone extends to a depth of 60 inches or more. These soils are used for grazing and irrigated crops.

Representative profile of Otero sandy loam, 0 to 1 percent slopes, in native grass, 0.25 mile south and 100 feet west of the north quarter corner of sec. 12, T. 26 S., R. 60 W.

A1—0 to 4 inches, light brownish-gray (10YR 6/2) sandy loam, dark grayish brown (10YR 4/2) when moist; weak, coarse, platy structure; slightly hard, very friable; nonsticky and nonplastic; mildly alkaline; clear, smooth boundary.

AC—4 to 12 inches, light brownish-gray (10YR 6/2) sandy loam, dark grayish brown (10YR 4/2) when moist; weak, coarse, subangular blocky structure; slightly hard, very friable; nonsticky and nonplastic; calcareous; moderately alkaline; clear, smooth boundary.

C1ca—12 to 30 inches, very pale brown (10YR 7/3) sandy loam, brown (10YR 5/3) when moist; moderate, medium, subangular blocky structure; hard, friable; nonsticky and slightly plastic; calcareous; common, medium, soft masses of lime; moderately alkaline; gradual, smooth boundary.

C2—30 to 42 inches, very pale brown (10YR 7/3) sandy loam, brown (10YR 5/3) when moist; massive; slightly hard, very friable; nonsticky and slightly plastic; few small masses of lime; moderately alkaline; clear, smooth boundary.

C3—42 to 60 inches, very pale brown (10YR 7/3) fine sandy loam, brown (10YR 5/3) when moist; massive; soft, very friable; nonsticky and nonplastic; calcareous; moderately alkaline.

The A horizon is gravelly sandy loam, loamy fine sand, fine sandy loam, sandy loam, or clay loam 3 to 14 inches thick. The C horizon in places is stratified gravelly loamy sand, loam, gravelly sandy loam, or sandy loam. The content of gravel ranges from 0 to 35 percent, and in places, at a depth of more than 40 inches gravel is the underlying material.

OoA—Otero sandy loam, 0 to 1 percent slopes. This soil is on high terraces along the Arkansas River. The areas are irregularly shaped and cover as much as 400 acres. This soil has the profile described as representative of the series.

Included with this soil in mapping are areas of Kim fine sandy loam that make up as much as 20 percent of the acreage.

Runoff is slow. The hazard of erosion is slight in irrigated areas and high in nonirrigated areas.

This soil is used for grazing and for irrigated hay and feed crops where irrigation water is available. It is well suited to irrigated crops and has a high production potential if adequate water is available. The native vegetation is mainly blue grama, sand dropseed, and yucca. Capability units I, irrigated, VIe–3, nonirrigated; Sandy Plains range site.

OoC—Otero sandy loam, 1 to 5 percent slopes. This soil is on high terraces along the Arkansas River and on uplands in the northeastern part of Pueblo County. The areas are irregularly shaped and cover as much as 400 acres. This soil has a profile similar to the one described as representative of the series, but in places gravel is at a depth of about 3 feet.

Included with this soil in mapping are areas of Cascajo very gravelly sandy loam that make up about 10 percent of the acreage.

Runoff is slow, and the hazard of erosion is high.

This soil is better suited to grazing than to other uses. It is suited to irrigated crops where adequate water is available. Only a small amount of the acreage is irrigated. The native vegetation is mainly blue grama, sand dropseed, galleta, yucca, and rabbitbrush. Capability units IIIe-1, irrigated, VIe–3, nonirrigated; Sandy Plains range site.

OrD—Otero gravelly sandy loam, 3 to 9 percent slopes. This soil is on alluvial fans at the foot of gravelly escarpments in the north-central part of Pueblo County. These areas are irregularly shaped and cover as much as 600 acres. This soil has a profile similar to the one described as representative of the series, but the surface layer is gravelly sandy loam and the underlying material is stratified loam to gravelly loamy sand that averages gravelly sandy loam.

Included with this soil in mapping are areas of Schamber soils that make up about 15 percent of the acreage, areas of Heldt soils that make up about 5 percent, and areas of Razor soils that make up less than 5 percent. The Heldt and Razor soils are on level or slightly concave surfaces, and the Schamber soils are on low ridges or knolls at the foot of escarpments.

Runoff is moderate, and the hazard of erosion is high.

This soil is suited to grazing and to irrigated crops where adequate water is available. The native vegetation is mainly blue grama, galleta, sand dropseed, fourwing saltbush, yucca, and cactus. Capability units IIIe–1, irrigated, VIe–3, nonirrigated; Sandy Plains range site.

OtA—Otero clay loam, 0 to 1 percent slopes. This soil is on high terraces along the Arkansas River. The areas are irregularly shaped and cover as much as 800 acres. This soil has a profile similar to the one described as representative of the series, but the surface layer is clay loam about 12 inches thick and in places the lower part of the underlying material is loam.

Included with this soil in mapping are areas of Rocky Ford silty clay loam that make up about 10 percent of the acreage.

Runoff is slow, and the hazard of erosion is slight.

This soil is used exclusively for irrigated corn, sorghum, alfalfa, small grain, grasses, and truck crops. Capability unit I, irrigated; not in a range site.

OtB—Otero clay loam, 1 to 3 percent slopes. This soil is on high terraces along the Arkansas River. The areas are irregularly shaped and cover as much as 300 acres. This soil has a profile similar to the one described as representative of the series, but the surface layer is clay loam about 10 inches thick.

Included with this soil in mapping are areas of Otero sandy loam that make up about 15 percent of the acreage.

Runoff is slow, and the hazard of erosion is slight.

This soil is used exclusively for such irrigated crops as corn, sorghum, alfalfa, and pasture. Capability unit IIe–1, irrigated; not in a range site.

Penrose Series

The Penrose series consists of shallow, somewhat excessively drained soils. These soils formed on upland hills and ridges in loamy residuum weathered from limestone. The slope is 1 to 65 percent, and elevation is 4,400 to 6,200 feet. The average annual precipitation is 12 inches. The average annual temperature is 53° F, and the frost-free season is 130 to 175 days. The native vegetation is mainly short and mid grasses of the plains.

In a representative profile the surface layer is light brownish-gray channery loam about 3 inches thick. The underlying material is light-gray channery loam about 9 inches thick. Gray, hard, interbedded limestone and marly shale is at a depth of 12 inches.

Permeability is moderate, and the available water capacity is very low. These soils are moderately alkaline. Their root zone extends to a depth of 10 to 20 inches. They are used almost exclusively for grazing.

Representative profile of Penrose channery loam, in an area of Penrose-Rock outcrop complex, 25 to 65 percent slopes, in grass, 0.47 mile south and 0.1 mile east of the northwest corner of sec. 9, T. 26 S., R. 60 W.

A1—0 to 3 inches, light brownish-gray (10YR 6/2) channery loam, dark grayish brown (10YR 4/2) when moist; weak, fine, granular structure; slightly hard, friable; nonsticky and slightly plastic; calcareous; 50 percent of the surface is covered by limestone fragments; moderately alkaline; abrupt, smooth boundary.

C—3 to 12 inches, light-gray (10YR 7/2) channery loam, brown (10YR 5/3) when moist; massive; slightly hard, friable; slightly sticky and slightly plastic; calcareous; 35 percent limestone fragments; moderately alkaline; abrupt, smooth boundary.

R—12 inches, gray, hard, interbedded limestone, 2 to 3 inches thick, and thin layers of marly shale.

In places the A1 horizon is free of lime. Channery and flaggy pieces of limestone that are ½ inch to 8 inches in diameter make up 15 to 35 percent of the soil. Bedrock is at a depth of 10 to 20 inches.

PmE—Penrose-Minnequa complex, 1 to 15 percent slopes. This complex is in all but the northeastern and western parts of the survey area. It is made up of about 60 percent Penrose channery loam, and the rest is equal parts of Manvel silt loam and Minnequa loam. Areas of this complex are irregularly shaped and cover as much as 800 acres. The Minnequa and Manvel soils are on the more level areas at the low end of the sloping Penrose soils.

The Penrose, Minnequa, and Manvel soils in this complex have the profile described as representative of their series.

Included with these soils in mapping are areas of Rock outcrop that make up about 10 percent of the acreage.

Runoff is rapid, and the hazard of erosion is slight.

This complex is better suited to grazing and wildlife habitat than to other uses. The native vegetation is mainly blue grama, side-oats grama, New Mexico needlegrass, indian ricegrass, yucca, Bigelow sagebrush, and some pinyon pine, juniper, skunkbush, and mountainmahogany. Capability unit VIIs–3, nonirrigated; Penrose soil in Limestone Breaks range site; Manvel and Minnequa soils in Loamy Plains range site.

PrF—Penrose-Rock outcrop complex, 25 to 65 percent slopes. This complex is in all but the northeastern and western parts of the survey area. It is made up of about 50 percent Penrose channery loam and 30 percent Rock outcrop of limestone and interbedded shale. Areas of this complex are long, narrow, and irregularly shaped and cover as much as 800 acres. Geologic erosion has cut steep V-shaped gullies into the limestone and shale.

The Penrose soil in this complex has the profile described as representative of the Penrose series.

Included in mapping are areas of Razor, Manvel, and Shingle soils that make up about 20 percent of the acreage.

Runoff is rapid, and the hazard of erosion is slight.

This complex is suited to wildlife habitat. Some areas are used for grazing. The native vegetation is mainly blue grama, side-oats grama, New Mexico needlegrass, indian ricegrass, yucca, Bigelow sage, and some pinyon pine, juniper, skunkbush, and mountainmahogany. Capability unit VIIs–3, nonirrigated; Penrose soil in Limestone Breaks range site; Rock outcrop not in a range site.

Pinata Series

The Pinata series consists of deep, well-drained soils. These soils formed on mountainsides in very stony colluvium and clayey residuum weathered mostly from sandstone. The slope is 25 to 65 percent, and elevation is 6,400 to 7,200 feet. The average annual precipitation is 20 inches. The average annual temperature is 45° F, and the frost-free season is 90 to 125 days. The native vegetation is mainly ponderosa pine forest.

In a representative profile the surface layer is gray very stony loam about 8 inches thick. The subsurface layer is gray very stony loam and reddish-brown very stony clay loam about 4 inches thick. The upper part of the subsoil is reddish-brown very stony clay about 27 inches thick, and the lower part, extending to a depth of 60 inches, is reddish-brown very stony clay loam.

Permeability is slow, and the available water capacity is high. The surface and subsurface layers are slightly acid and the subsoil is neutral. The root zone extends to a depth of more than 60 inches. These soils are used for grazing.

Representative profile of Pinata very stony loam, in an area of Pinata-Wetmore association, in native forest, 0.2 mile north of the south quarter corner of sec. 22, T. 21 S., R. 69 W.

O2—2 inches to 0, slightly decomposed grass, leaves, pine needles, and pine cones.

A2—0 to 8 inches, gray (10YR 5/1) very stony loam, very dark gray (10YR 3/1) when moist; weak, coarse, crumb structure; slightly hard, very friable; slightly sticky and slightly plastic; about 70 percent rock fragments, of which half are larger than 3 inches; slightly acid; clear, wavy boundary.

B&A—8 to 12 inches, A part of horizon is gray (10YR 5/1) very stony loam that has weak, very fine, crumb struc-

ture and is slightly hard; B part is reddish-brown (5YR 5/3) heavy clay loam, dark reddish brown (5YR 3/3) when moist, that has moderate, fine, angular blocky structure and is very hard, very firm; slightly sticky and plastic; thick coating and fingerlike gray (10YR 5/1) loam on and between peds; 50 percent rock fragments, of which half are larger than 3 inches; slightly acid; clear, wavy boundary.

B21—12 to 22 inches, reddish-brown (2.5YR 5/3) very stony clay, reddish brown (2.5YR 4/4) when moist; moderate, medium, angular blocky structure; extremely hard, very firm; sticky and very plastic; moderately thick clay films on 50 to 90 percent of the peds; 25 percent rock fragments, of which 5 percent is larger than 3 inches; neutral; gradual, wavy boundary.

B22ca—22 to 39 inches, reddish-brown (2.5YR 5/3) very stony clay, reddish brown (2.5YR 4/3) when moist; moderate, medium, angular blocky structure; extremely hard, very firm; sticky and very plastic; moderately thick clay films on 50 to 90 percent of the peds; 40 percent rock fragments, of which half are larger than 3 inches; thin lime coatings on bottom of pebbles and stones; neutral; gradual, wavy boundary.

B3ca—39 to 60 inches, reddish-brown (5YR 5/3) very stony heavy clay loam, reddish brown (5YR 4/3) when moist; moderate, medium, angular blocky structure; very hard, very firm; sticky and plastic; moderately thick clay films on 25 to 50 percent of the peds; 50 percent rock fragments, of which about two-thirds are larger than 3 inches; noncalcareous; thin lime coatings on the bottom of pebbles and stones; neutral.

The A2 horizon is 4 to 18 inches thick. The B2 horizon is clay or gravelly sandy clay to gravelly clay loam. Rock fragments make up 35 to 70 percent of the soil, and some are more than 10 inches in diameter. The soil is slightly acid in the upper part of the profile and neutral to mildly alkaline in the lower part.

PW—Pinata-Wetmore association. This association is in the foothills and mountains in the western part of the survey area. It is made up of about 40 percent Pinata very stony loam and 35 percent Wetmore stony sandy loam. The areas are irregularly shaped and cover as much as 1,500 acres. The Pinata soil is at the base of sandstone scarps and on hogbacks. The Wetmore soil is on mountainsides over granite.

The Pinata soil in this association has the profile described as representative of the Pinata series, but in places the subsoil extends to a depth of 60 inches. The slope is 25 to 40 percent. The Wetmore soil has a profile similar to the one described as representative of the Wetmore series, but the subsoil is sandy clay loam. Also, it is on southern exposures, is drier, and has a different plant cover. The slope is 30 to 60 percent.

Included with these soils in mapping are areas of stony fine-loamy soils that are moderately deep over granite bedrock. These soils make up about 10 percent of the acreage. Also included are areas of soils that are similar to Nederland soils but have an average annual soil temperature of about 45° F. These soils make up about 5 percent of the acreage. Other areas included are Larkson soils that make up about 10 percent.

Runoff is medium, and the hazard of erosion is slight.

This soil has potential for recreation use and for wildlife habitat if it is well managed. The native vegetation is mainly ponderosa pine, Gambel oak, mountain-mahogany, and bluegrass. Capability unit VIIs–4, nonirrigated; Pinata soil in woodland suitability group 6x2; Wetmore soil in woodland suitability group 6x1; not in a range site.

Razor Series

The Razor series consists of moderately deep, well-drained soils. These soils formed on uplands in clayey residuum weathered from shale. They are underlain by shale at a depth of 20 to 40 inches. The slope is 1 to 5 percent, and elevation is 4,400 to 5,400 feet. The average annual precipitation is 12 inches. The average annual temperature is 53° F, and the frost-free season is 145 to 175 days. The native vegetation is mainly short plains grasses.

In a representative profile (fig. 5) the surface layer is light olive-brown heavy clay loam about 4 inches thick. The subsoil is grayish-brown silty clay about 11 inches thick. The underlying material is light brownish-gray clay about 15 inches thick over light brownish-

Figure 5.—Profile of Razor clay loam. The surface layer is heavy clay loam about 4 inches thick, and the subsoil is silty clay to a depth of about 11 inches.

gray soft shale that extends to a depth of 60 inches or more.

Permeability is slow, and the available water capacity is low. These soils are moderately alkaline. Their root zone extends to a depth of 20 to 40 inches. They are used almost exclusively for grazing.

Representative profile of Razor clay loam, in grass, about 0.2 mile west and 0.2 mile south of the northeast corner of sec. 9, T. 19 S., R. 65 W.

A—0 to 4 inches, light olive-brown (2.5Y 5/4) clay loam, olive brown (2.5Y 4/4) when moist; weak, fine, granular structure; loose, firm; sticky and plastic; calcareous; moderately alkaline; abrupt, smooth boundary.

B2—4 to 15 inches, grayish-brown (2.5Y 5/2) silty clay, dark grayish brown (2.5Y 4/2) when moist; weak, medium, subangular blocky structure; extremely hard, firm; sticky and very plastic; calcareous; moderately alkaline; clear, smooth boundary.

C1cs—15 to 30 inches, light brownish-gray (2.5Y 6/2) clay, olive brown (2.5Y 4/4) when moist; weak, fine, subangular blocky structure; slightly hard, firm; sticky and plastic; calcareous; small soft masses of crystalline gypsum; moderately alkaline; clear, smooth boundary.

C2—30 to 60 inches, light brownish-gray (2.5Y 6/2) weathered shale, olive brown (2.5Y 4/4) when moist.

The A horizon is clay loam or clay 2 to 4 inches thick. The B2 horizon is clay to silty clay loam that has moderate or weak structure. The Ccs horizon is at a depth of 15 to 27 inches. Depth to shale ranges from 20 to 40 inches.

Ra—Razor clay loam. This soil is in the north-central part of the survey area. The slope ranges from 1 to 5 percent but is mostly less than 3 percent. The areas are irregularly shaped and cover as much as 1,000 acres. This soil has the profile described as representative of the series.

Included with this soil in mapping are areas of Heldt soils and shallow clay over clay shale. These areas make up about 25 percent of the acreage.

Runoff is medium, and the hazard of erosion is moderate.

This soil is better suited to grazing than to other uses. It has potential for wildlife use if the habitat can be improved. The native vegetation is mainly blue grama, galleta, and alkali sacaton. Capability unit VIe–2, nonirrigated; Alkaline Plains range site.

Re2—Razor clay, eroded. This soil is in the north-central part of the survey area. The slope ranges from 1 to 5 percent but is mostly less than 3 percent. The areas are irregularly shaped and cover as much as 1,000 acres. This soil has a profile similar to the one described as representative of the series, but erosion has removed most of the surface layer on about two-thirds of the acreage. Also, runoff water has eroded the soil surface, and rills and small gullies have formed.

Included with this soil in mapping are areas of shallow clay over clay shale. These areas make up about 20 percent of the acreage. They are on knolls and small pointed buttes.

Runoff is medium, and the hazard of erosion is moderate.

This soil is better suited to grazing than to other uses. It has potential for wildlife use if the habitat can be improved. The main native grass is alkali sacaton. Capability unit VIe–2, nonirrigated; Alkaline Plains range site.

Rocky Ford Series

The Rocky Ford series consists of deep, well-drained soils. These soils formed on terraces in silty alluvium. The slope is 0 to 3 percent, and elevation is 4,300 to 5,000 feet. The average annual precipitation is 12 inches. The average annual temperature is 53° F, and the frost-free season is 145 to 175 days.

In a representative profile the surface layer is grayish-brown silty clay loam about 12 inches thick. The underlying material is pale-brown silt loam that extends to a depth of 60 inches or more.

Permeability is moderate, and the available water capacity is high. These soils are moderately alkaline. Their root zone extends to a depth of more than 60 inches. They are used for irrigated crops and hay.

Representative profile of Rocky Ford silty clay loam, 0 to 1 percent slopes, in irrigated cropland, 0.1 mile east of the west quarter corner of sec. 8, T. 21 S., R. 62 W.

Ap—0 to 12 inches, grayish-brown (10YR 5/2) silty clay loam, dark grayish brown (10YR 4/2) when moist; weak, coarse, subangular blocky structure parting to moderate, medium to fine, granular; hard, friable; slightly sticky and slightly plastic; calcareous; moderately alkaline; abrupt, smooth boundary.

C1ca—12 to 42 inches, pale-brown (10YR 6/3) silt loam, brown (10YR 5/3) when moist; weak, medium, subangular blocky structure; slightly hard, very friable; slightly sticky and plastic; calcareous; few, small, rounded masses of segregated lime; moderately alkaline; gradual, smooth boundary.

C2—42 to 60 inches, pale-brown (10YR 6/3) silt loam, brown (10YR 5/3) when moist; weak, medium, subangular blocky structure; hard, very friable; slightly sticky and slightly plastic; calcareous; moderately alkaline.

The A horizon is clay loam or silty clay loam 10 to 15 inches thick. The C2 horizon is mostly silty clay loam or silt loam, but in places it is stratified loamy very fine sand, fine sandy loam, silt loam, and silty clay loam.

RfA—Rocky Ford silty clay loam, 0 to 1 percent slopes. This soil is on high terraces along the Arkansas River. The areas are elongated and cover as much as 1,200 acres. This soil has the profile described as representative of the series.

Included with this soil in mapping are small areas of Otero clay loam.

Runoff is slow, and the hazard of erosion is slight.

This soil is well suited to irrigated crops, corn, sorghum, small grain, alfalfa, vegetables, and pasture. Capability unit I, irrigated; range site not assigned.

RfB—Rocky Ford silty clay loam, 1 to 3 percent slopes. This soil is on high terraces along the Arkansas River. The areas are elongated and cover as much as 600 acres. This soil has a profile similar to the one described as representative of the series.

Included with this soil in mapping are areas of Otero clay loam and Otero sandy loam that make up 10 percent of the acreage.

Runoff is slow, and the hazard of erosion is slight.

This soil is well suited to irrigated crops. Capability unit IIe–1, irrigated; range site not assigned.

Rg—Rocky Ford silty clay loam, wet. This is a nearly level soil on low terraces of the Arkansas River. The areas are irregularly shaped and cover as much as 100 acres. This soil has a profile similar to the one

described as representative of the series, but the subsoil is stratified loamy very fine sand, fine sandy loam, silt loam, and silty clay loam.

Runoff is slow, and the hazard of erosion is slight. The soil is subject to occasional, brief flooding. A seasonal high water table is generally at a depth of 2½ to 4 feet, but in some seasons it is lower than 4 feet. There is a low concentration of salts on the surface and in the surface layer in some years.

This soil is suited to irrigated crops. It is not suited to vegetable crops or any crop that has a low salt tolerance unless the soil has been drained and the water table has been lowered. Capability unit IIw–1, irrigated; range site not assigned.

Schamber Series

The Schamber series consists of deep, somewhat excessively drained soils. These soils formed on high terraces in sandy alluvium. The slope is 5 to 25 percent, and elevation is 4,400 to 5,300 feet. The average annual precipitation is 12 inches. The average annual temperature is 53° F, and the frost-free season is 130 to 160 days. The native vegetation is mainly mid grasses of the plains.

In a representative profile (fig. 6) the surface layer is grayish-brown gravelly sandy loam about 5 inches thick. The subsurface layer is grayish-brown very gravelly sandy loam about 4 inches thick. The underlying material is light brownish-gray very gravelly loamy sand about 26 inches thick over very pale brown very gravelly loamy sand that extends to a depth of 60 inches or more.

Figure 6.—Profile of Schamber gravelly sandy loam. This soil is used for grazing and as a source of gravel.

Permeability is rapid, and the available water capacity is low. The surface layer is mildly alkaline, and the underlying material is moderately alkaline. The root zone extends to a depth of more than 60 inches. These soils are used for grazing and are a source of gravel.

Representative profile of Schamber gravelly sandy loam, 5 to 25 percent slopes, in grass, 0.5 mile east and 0.05 mile north of the southwest corner of sec. 21, T. 19 S., R. 64 W.

A1—0 to 5 inches, grayish-brown (10YR 5/2) gravelly sandy loam, very dark grayish brown (10YR 3/2) when moist; moderate, medium, granular structure; slightly hard, very friable; nonsticky and slightly plastic; mildly alkaline; clear, smooth boundary.

AC—5 to 9 inches, grayish-brown (10YR 5/2) very gravelly sandy loam, dark grayish brown (10YR 4/2) when moist; weak, medium, subangular blocky structure; slightly hard, very friable; nonsticky and nonplastic; 60 percent gravel; calcareous; moderately alkaline; gradual, smooth boundary.

C1—9 to 35 inches, light brownish-gray (10YR 6/2) very gravelly loamy sand, grayish brown (10YR 5/2) when moist; single grained; slightly hard, very friable; nonsticky and nonplastic; 60 percent gravel; calcareous; moderately alkaline; gradual, smooth boundary.

C2ca—35 to 60 inches, very pale brown (10YR 8/3) very gravelly loamy sand, pale brown (10YR 6/3) when moist; single grained; slightly hard, very friable; nonsticky and nonplastic; 45 percent gravel; calcareous; moderately alkaline.

The A1 horizon is gravelly sandy loam or gravelly loamy sand 3 to 8 inches thick. Depth to lime ranges from 15 to 65 inches but is less than 40 inches in most places. The content of gravel, mostly fine gravel, ranges from 25 to 65 percent.

SaE—Schamber gravelly sandy loam, 5 to 25 percent slopes. This soil is on high terrace edges in the north-central part of the survey area. The areas are long and narrow and cover as much as 1,000 acres. This soil has the profile described as representative of the series, but in areas on the Ft. Carson Military reservation it is redder. Also, in some places there are clay balls as much as 12 inches in diameter, and in others the underlying material is slightly sticky and slightly plastic.

Included with this soil in mapping are areas of Gilcrest soils; these make up about 20 percent of the acreage.

Runoff is rapid, and the hazard of erosion is slight.

This soil is suited to grazing and is a source of gravel. It has potential for wildlife use if the habitat can be improved. The native vegetation is mainly blue grama, sand dropseed, and sage, cactus, and yucca. Capability unit VIIs–2, nonirrigated; Gravel Breaks range site.

Shingle Series

The Shingle series consists of shallow, well-drained soils. These soils formed on uplands in loamy residuum that weathered from shale. They are underlain by soft

shale at a depth of 10 to 20 inches. The slope is 1 to 9 percent, and elevation is 4,400 to 5,800 feet. The average annual precipitation is 12 inches. The average annual temperature is 53° F, and the frost-free season is 145 to 175 days. The native vegetation is mainly short grasses of the plains.

In a representative profile the surface layer is light brownish-gray silty clay loam about 3 inches thick. The subsurface layer is pale-brown silty clay loam about 4 inches thick. The underlying material is light-gray silty clay loam about 6 inches thick. Light-gray soft shale is at a depth of about 13 inches.

Permeability is moderate, and the available water capacity is low. These soils are moderately alkaline. Their root zone extends to a depth of 10 to 20 inches. They are used for grazing.

Representative profile of Shingle silty clay loam, 1 to 9 percent slopes, in grass, 0.3 mile south and 0.17 mile east of the northwest corner of sec. 26, T. 26 S., R. 60 W.

A—0 to 3 inches, light brownish-gray (10YR 6/2) silty clay loam, dark grayish brown (10YR 4/2) when moist; moderate, very fine, granular structure; loose, friable; slightly sticky and plastic; calcareous; moderately alkaline; abrupt, smooth boundary.

AC—3 to 7 inches, pale-brown (10YR 6/3) silty clay loam, brown (10YR 5/3) when moist; weak, medium and fine, subangular blocky structure; hard, friable; slightly sticky and plastic; calcareous; moderately alkaline; abrupt, smooth boundary.

C1—7 to 13 inches, light-gray (10YR 7/2) silty clay loam, gray (10YR 4/1) when moist; weak, medium, subangular block structure; hard, friable; sticky and plastic; calcareous; moderately alkaline; abrupt, wavy boundary.

C2—13 inches, light-gray (10YR 7/2) soft shale.

The A horizon is clay loam or silty clay loam 3 to 8 inches thick. The C horizon is clay loam or silty clay loam 6 to 17 inches thick. It has a small amount of small chips of weathered limestone or shale. Depth to soft, calcareous shale ranges from 10 to 20 inches.

SgD—Shingle silty clay loam, 1 to 9 percent slopes. This soil is scattered over the plains part of Pueblo County. The slope ranges from 1 to 9 percent but is mainly less than 5 percent. The areas cover as much as 80 acres.

Included with this soil in mapping are areas of Minnequa soils, which make up about 10 percent of the acreage.

Runoff is medium, and the hazard of erosion is moderate.

This soil is better suited to grazing than to other uses. The native vegetation is mainly alkali sacaton, western wheatgrass, blue grama, galleta, winterfat, and some cactus. Capability unit VIIs–1, nonirrigated; Shaly Plains range site.

Stoneham Series

The Stoneham series consists of deep, well-drained soils. These soils formed on high terraces in loamy alluvium. The slope is 0 to 3 percent, and elevation is 4,500 to 5,500 feet. The average annual precipitation is 12 inches. The average annual temperature is 53° F, and the frost-free season is 145 to 175 days. The native vegetation is mainly short plains grasses.

In a representative profile the surface layer is light brownish-gray loam about 4 inches thick. The upper part of the subsoil is brown clay loam about 3 inches thick, and the lower part is pale-brown clay loam about 7 inches thick. The underlying material is very pale brown and pale brown loam that extends to a depth of 60 inches or more.

Permeability is moderate, and the available water capacity is high. The surface layer and the upper part of the subsoil are mildly alkaline, and the lower part of the subsoil is moderately alkaline. The root zone extends to a depth of more than 60 inches. These soils are used almost exclusively for grazing.

Representative profile of Stoneham loam, in grass, 100 feet north of the center of sec. 14, T. 18 S., R. 65 W.

A1—0 to 4 inches, light brownish-gray (10YR 6/2) loam, dark brown (10YR 3/3) when moist; weak, medium, platy structure parting to weak, fine, granular; slightly hard, friable; slightly sticky and slightly plastic; mildly alkaline; clear, smooth boundary.

B2t—4 to 7 inches, brown (10YR 5/3) clay loam, dark brown (10YR 4/3) when moist; moderate, medium, prismatic structure parting to moderate, medium, subangular blocky; hard, friable; sticky and plastic; thin, patchy, clay films on peds; mildly alkaline; clear, smooth boundary.

B3ca—7 to 14 inches, pale-brown (10YR 6/3) clay loam, dark brown (10YR 4/3) when moist; weak, coarse, prismatic structure parting to weak, medium, subangular blocky; hard, friable; slightly sticky and slightly plastic; calcareous; small soft masses of lime; moderately alkaline; clear, smooth boundary.

C1ca—14 to 28 inches, very pale brown (10YR 7/3) loam, brown (10YR 5/3) when moist; massive; hard, friable; slightly sticky and slightly plastic; calcareous; small soft masses of lime; moderately alkaline; clear, gradual boundary.

C2—28 to 60 inches, pale-brown (10YR 6/3) loam, brown (10YR 5/3) when moist; massive; slightly hard, friable; nonsticky and slightly plastic; calcareous; moderately alkaline.

The A1 horizon is loam, fine sandy loam, or sandy loam 3 to 6 inches thick. The B horizon is clay loam or sandy clay loam 5 to 12 inches thick. In places the lower part of the C horizon is sandy loam and is as much as 15 percent fine gravel.

Sh—Stoneham loam. This soil is mostly in the north-central part of the survey area. The areas are irregularly shaped and cover as much as 1,200 acres. This soil has the profile described as representative of the series, but in places the upper part of the subsoil has weaker structure and is calcareous.

Included with this soil in mapping are areas of Kim soils, mostly on the perimeter of the mapped areas, and areas of Otero and Olney soils. These soils make up about 20 percent of the acreage.

Runoff is medium, and the hazard of erosion is moderate.

This soil is well suited to grazing. It has a high potential for wildlife use if the habitat can be improved. The native vegetation is mainly blue grama, galleta, sand dropseed, and cactus. Capability unit VIe–1, nonirrigated; Loamy Plains range site.

Stroupe Series

The Stroupe series consists of moderately deep, well-drained soils. These soils formed on mesas and foothills in clayey residuum weathered from sandstone. They are underlain by sandstone at a depth of 20 to

40 inches. The slope is 9 to 25 percent, and elevation is 5,800 to 6,500 feet. The average annual precipitation is 18 inches. The average annual temperature is 47° F, and the frost-free season is 115 to 145 days. The native vegetation is mainly foothill grasses and shrubs.

In a representative profile the surface layer is brown extremely stony loam about 4 inches thick. The upper part of the subsoil is brown very stony loam about 5 inches thick, and the lower part is reddish-brown very stony clay loam about 16 inches thick. Sandstone bedrock is at a depth of about 25 inches.

Permeability is slow, and the available water capacity is low. The surface layer and subsoil are neutral, and the underlying material is neutral or mildly alkaline. The root zone extends to a depth of 20 to 40 inches. These soils are used almost exclusively for grazing.

Representative profile of Stroupe extremely stony loam, 9 to 25 percent slopes, in native grass, 0.2 mile west and 0.1 mile south of the northeast corner of sec. 4, T. 22 S., R. 68 W.

A1—0 to 4 inches, brown (7.5YR 5/2) extremely stony loam, dark brown (7.5YR 3/2) when moist; moderate, coarse, granular structure parting to very fine, granular; slightly hard, very friable; slightly sticky and slightly plastic; 60 percent rock fragments; neutral; clear, smooth boundary.

B1—4 to 9 inches, brown (7.5YR 5/2) very stony loam, dark brown (7.5YR 3/2) when moist; moderate medium and fine, subangular blocky structure; slightly hard, very friable; slightly sticky and slightly plastic; thin, patchy, clay films on peds; 50 percent rock fragments; neutral; clear, smooth boundary.

B2t—9 to 25 inches, reddish-brown (5YR 5/4) very stony clay loam, reddish brown (5YR 4/4) when moist; moderate, medium, angular blocky structure; very hard, very firm; sticky and very plastic; moderate clay films on peds; 60 percent fragments; neutral; gradual, irregular boundary.

R—25 inches, sandstone bedrock.

The A horizon is 4 to 10 inches thick. In places it is clay loam in the lower part. The B horizon is 7 to 21 inches thick. The B2t horizon ranges from stony clay to very stony clay loam. In places there is a weakly developed lime zone at a depth of 20 inches or more. In this zone, thin lime coatings are on the bottom of rock fragments.

StE—Stroupe extremely stony loam, 9 to 25 percent slopes. This soil is in the western part of the survey area in long areas that cover as much as 1,800 acres. Flaggy sandstone fragments cover about 10 percent of the soil surface.

Included with this soil in mapping are areas of sandstone Rock outcrop; these make up about 15 percent of the acreage.

Runoff is medium, and the hazard of erosion is slight.

This soil is suited to grazing. It has potential for wildlife use if the habitat can be improved. Herbage production is limited by the low available moisture capacity. About one-third of the acreage is pinyon-juniper woodland, and the rest is grassland. The native vegetation is mainly western wheatgrass, blue grama, side-oats grama, yucca, cactus, mountainmahogany, pinyon pine, and juniper. Capability unit VIIs–3, nonirrigated; Shallow Foothills range site.

Table Mountain Series

The Table Mountain series consists of deep, well-drained soils. These soils formed in alluvium in ravines and small valleys. The slope is 1 to 6 percent, and the elevation is 5,700 to 6,800 feet. The average annual precipitation is 18 inches. The average annual temperature is 47° F, and the frost-free season is 115 to 145 days. The native vegetation is mainly foothills grasses.

In a representative profile the surface layer is grayish-brown loam about 10 inches thick. The underlying material is grayish-brown silt loam or loam that extends to a depth of 60 inches or more.

Permeability is moderate, and the available water capacity is high. These soils are moderately alkaline. The root zone extends to a depth of more than 60 inches. These soils are used for grazing and hay.

Representative profile of Table Mountain loam, in an area of Table Mountain association, in a ravine in a hayfield, about 0.5 mile north and 0.1 mile west of the southeast corner of sec. 35, T. 24 S., R. 67 W.

A1—0 to 7 inches, grayish-brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) when moist, fine, granular structure; soft, very friable; nonsticky and slightly plastic; many very fine roots; calcareous; moderately alkaline; clear, smooth boundary.

B2—7 to 17 inches, grayish-brown (10YR 5/2) loam, very dark brown (10YR 2/2) when moist; weak, coarse, prismatic structure parting to weak, medium, angular blocky; soft, very friable; slightly sticky and slightly plastic; common fine and very fine roots; thin, clay films in pores and old root channels; calcareous; moderately alkaline; gradual, smooth boundary.

C1ca—17 to 38 inches, grayish-brown (10YR 5/2) silt loam, very dark brown (10YR 2/2) when moist; weak, coarse, prismatic structure parting to weak, medium, angular blocky; slightly hard, very friable; slightly sticky and slightly plastic; common fine and very fine roots; calcareous; filaments and threads of lime on peds; moderately alkaline; clear, smooth boundary.

C2—38 to 60 inches, grayish-brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) when moist; weak, coarse, prismatic structure; slightly hard, very friable; slightly sticky and slightly plastic; calcareous; filaments and threads of lime; moderately alkaline.

The content of fine gravel ranges from 0 to 10 percent. The A horizon is fine sandy loam, loam, or light clay loam. The B and C horizons are loam, silt loam, or silty clay loam.

Table Mountain soils in the Pueblo Area are outside the range of characteristics for the series because they are calcareous to the surface and are grayish brown to a depth of 50 inches or more. These differences do not affect the use, behavior, or management of the soils.

TM—Table Mountain association. This association is in small valleys and on creek terraces in the western part of the survey area. It is made up of about 80 percent Table Mountain soils. The slope ranges from 1 to 6 percent but is mainly less than 3 percent. Areas of these soils are irregularly shaped and cover as much as 200 acres.

Table Mountain loam, in this association, has the profile described as representative of the Table Mountain series. The other Table Mountain soils in the association have a profile similar to the representative one, except for the texture of the surface layer.

Included with these soils in mapping are small areas of stony or bouldery sandy alluvium along drainageways. These areas make up as much as 20 percent of the acreage. Also included, along Turkey Creek and Red Creek, are areas of soils that are similar to Table Mountain soils but are redder and are subject to rare or occasional, brief flooding.

Runoff is slow, and the hazard of erosion is moderate.

Most of the acreage is used for irrigated and dryland alfalfa. The native vegetation is mainly needlegrass, wheatgrass, and some cottonwoods, and Gambel oak along the creek channels. Capability units IIe–1, irrigated, IIIe–1, nonirrigated; Loamy Foothills range site.

Travessilla Series

The Travessilla series consists of shallow, well-drained soils. These soils formed on uplands in residuum that weathered from sandstone. They are underlain by bedrock between depths of 10 and 20 inches. The slope is 1 to 90 percent, and elevation is 4,500 to 5,500 feet. The average annual precipitation is 12 inches. The average annual temperature is 53° F, and the frost-free season is 130 to 175 days. The native vegetation is mainly plains grasses and juniper.

In a representative profile the surface layer is pinkish-gray sandy loam about 6 inches thick. The subsurface layer is light-brown sandy loam about 4 inches thick. The underlying material is pale-brown loam about 4 inches thick. Hard sandstone is at a depth of about 14 inches.

Permeability is moderate, and the available water capacity is low. The surface layer is mildly alkaline, and the underlying material is moderately alkaline. The root zone extends to a depth of 10 to 20 inches. These soils are used for grazing, watershed, and wildlife habitat.

Representative profile of Travessilla sandy loam, 1 to 9 percent slopes, in native grass, 0.3 mile north and 0.15 mile east of the southwest corner of sec. 20, T. 26 S., R. 60 W.

A1—0 to 6 inches, pinkish-gray (7.5YR 6/2) sandy loam, dark brown (7.5YR 4/2) when moist; weak, thin, platy structure; slightly hard, very friable; nonsticky and nonplastic; few, small, angular pebbles; weakly calcareous; moderately alkaline; clear, smooth boundary.

AC—6 to 10 inches, light-brown (7.5YR 6/4) sandy loam, dark brown (7.5YR 4/4) when moist; weak, fine, subangular blocky structure; slightly hard, very friable; nonsticky and slightly plastic; few, small, angular pebbles; strongly calcareous; moderately alkaline; clear, smooth boundary.

Cca—10 to 14 inches, pale-brown (10YR 6/3) loam, brown (10YR 5/3) when moist; massive; slightly hard, very friable; nonsticky and slightly plastic; strongly calcareous; concentrations of segregated lime in places; moderately alkaline; abrupt, smooth boundary.

R—14 inches, hard Dakota sandstone.

The A and C horizons are loam or sandy loam. The A horizon is 4 to 7 inches thick and in places is noncalcareous. In places the Cca horizon has coarse fragments that have coatings of lime on their underside. Depth to the R horizon ranges from 10 to 20 inches. The content of coarse fragments, mostly angular pebbles and channery pieces of sandstone, ranges from about 10 to 30 percent.

ToD—Travessilla sandy loam, 1 to 9 percent slopes. This soil is in the southern and western parts of the survey area in long areas that cover as much as 1,000 acres. This soil has the profile described as representative of the series, but on about 30 percent of the acreage the surface layer is loam and slopes are convex and about 3 percent.

Included with this soil in mapping are areas of Kim loam and Rock outcrop; each of these make up about 10 percent of the acreage.

Runoff is rapid, and the hazard of erosion is slight.

This soil has potential for recreation use and for wildlife use if the habitat can be improved. The native vegetation is mainly cactus, yucca, grama, needlegrass, and small juniper trees. Capability unit VIIs–3, nonirrigated; Sandstone Breaks range site.

TrG—Travessilla-Rock outcrop complex, 30 to 90 percent slopes. This complex is on side slopes and nearly vertical canyon walls in the southern part of Pueblo County. It is made up of about 40 percent Travessilla sandy loam and 40 percent Rock outcrop. Areas of this complex are elongated and cover as much as 800 acres.

The Travessilla soil in this complex has a profile similar to the one described as representative of the Travessilla series.

Included with these soils in mapping are areas of Wiley loam and Kim loam; these make up about 20 percent of the acreage.

Runoff is rapid, and the hazard of erosion is slight.

Most of the acreage is steep and rocky and provides only limited grazing. The native vegetation is mainly a sparse stand of grass and scattered stands of juniper. Capability unit VIIs–3, nonirrigated; Travessilla soil in Sandstone Breaks range site; Rock outcrop not in a range site.

Valent Series

The Valent series consists of deep, excessively drained soils. These soils formed on uplands in eolian sand. The slope is 1 to 7 percent, and elevation is 4,400 to 5,200 feet. The average annual precipitation is 12 inches. The average annual temperature is 52° F, and the frost-free season is 130 to 160 days. The native vegetation is mainly mid plains grasses.

In a representative profile the surface layer is light brownish-gray loamy sand about 4 inches thick. The underlying material is pale-brown fine sand about 31 inches thick over very pale brown fine sand that extends to a depth of 60 inches or more.

Permeability is very rapid, and the available water capacity is low. The surface layer is mildly alkaline, and the underlying material is neutral. The root zone extends to a depth of more than 60 inches. These soils are used for grazing.

Representative profile of Valent loamy sand, in grass, 0.2 mile west and 0.35 mile south of the northeast corner of sec. 22, T. 20 S., R. 60 W.

A1—0 to 4 inches, light brownish-gray (10YR 6/2) loamy sand, grayish brown (10YR 5/2) when moist; single grained; loose; nonsticky and nonplastic; mildly alkaline; clear, smooth boundary.

C1—4 to 35 inches, pale-brown (10YR 6/3) fine sand, brown (10YR 5/3) when moist; single grained; loose; nonsticky and nonplastic; mildly alkaline; diffuse, smooth boundary.

C2—35 to 60 inches, very pale brown (10YR 7/4) fine sand, yellowish brown (10YR 5/4) when moist; single grained; loose; nonsticky and nonplastic; neutral.

The A horizon is loamy fine sand or fine sand 4 to 10 inches thick. The C horizon is sand or fine sand. In places, lime is at a depth of 40 to 60 inches.

Va—Valent loamy sand. This soil is in the northeastern part of Pueblo County. The slope ranges from 1 to 7 percent but is mainly less than 5 percent. The areas cover as much as several square miles. This soil has the profile described as representative of the series, but in about 25 percent of the acreage it has dunelike relief and the ridges have a northwest-southeast orientation.

Included with this soil in mapping are areas of Vona loamy sand, which make up about 10 percent of the acreage.

Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is high, and wind blowouts range from 1 to 40 acres in size but most are less than 5 acres. They are shown on the detailed soil map by a symbol for blowout. The dunelike ridges are highly susceptible to soil blowing.

This soil is better suited to grazing than to other uses. Blowouts and roads that cut through this soil are difficult to reseed to grass. The native vegetation is mainly sand bluestem, sandreed, blue grama, sand dropseed, sand sage, and yucca. Capability unit VIe–3, nonirrigated; Deep Sand range site.

Vamer Series

The Vamer series consists of shallow, well-drained soils. These soils formed on mesas and ridgetops in clayey residuum weathered from sandstone. They are 10 to 20 inches deep to bedrock. The slope is 5 to 25 percent, and elevation is 6,500 to 7,200 feet. The average annual precipitation is 18 inches. The average annual temperature is 45° F, and the frost-free season is 90 to 125 days. The native vegetation is mainly ponderosa pine.

In a representative profile the surface layer is grayish-brown very stony loam about 2 inches thick. The subsurface layer is pinkish-gray very stony clay loam about 4 inches thick. The subsoil is brown heavy very stony clay loam about 6 inches thick. Sandstone bedrock is at a depth of about 12 inches.

Permeability is slow, and the available water capacity is very low. The surface layer is neutral, and the subsoil is neutral or moderately alkaline. The root zone extends to a depth of 10 to 20 inches. These soils are used almost exclusively for grazing.

Representative profile of Vamer very stony loam, in an area of Vamer-Rock outcrop complex, 5 to 25 percent slopes, in native forest, about 0.4 mile east and 0.2 mile south of the northwest corner of sec. 30, T. 24 S., R. 67 W.

O2—½ inch to 0, partly decomposed needles, leaves, and limbs; very dark when wet; abrupt, smooth boundary.

A2—0 to 2 inches, grayish-brown (10YR 5/2) very stony loam, very dark grayish brown (10YR 3/2) when moist; weak, fine, platy structure parting to weak, fine, granular; soft, very friable; nonsticky and slightly plastic; about 20 percent stones; neutral; abrupt, smooth boundary.

A&B—2 to 6 inches, pinkish-gray (7.5YR 6/2) very stony clay loam, dark brown (7.5YR 4/2) when moist; weak to moderate, fine, subangular blocky structure; slightly hard, friable; nonsticky and slightly plastic; thin, patchy, clay films on peds; about 20 percent stones; neutral; clear, smooth boundary.

B2t—6 to 12 inches, light-brown (7.5YR 6/4) heavy very stony clay loam, dark brown (7.5YR 4/4) when moist; strong, fine, subangular blocky structure; hard, firm; sticky and very plastic; about 30 percent stones; thin, continuous, clay films on peds; neutral; abrupt, smooth boundary.

R—12 inches, fractured sandstone.

Depth to bedrock ranges from 10 to 20 inches. The content of rock fragments ranges from 15 to 35 percent, and most of these fragments are more than 6 inches long.

VmE—Vamer-Rock outcrop complex, 5 to 25 percent slopes. This complex is in the western part of the survey area. It is made up of about 80 percent Vamer stony loam and 20 percent sandstone Rock outcrop. Areas of this complex cover as much as 1,000 acres.

The Vamer soil in this complex has the profile described as representative of the Vamer series.

Runoff is medium, and the hazard of erosion is slight.

This complex is suited to limited grazing. It has potential for wildlife use if the habitat can be improved. Timber production is low; woodland products are fenceposts and corral poles. The native vegetation is mainly ponderosa pine, Gambel oak, mountain-mahogany, bluegrass, needlegrass, and blue grama. Capability unit VIIs–4, nonirrigated; woodland suitability group 6x1; not in a range site.

Vona Series

The Vona series consists of deep, well-drained soils that formed on uplands in windblown sand. The slope is 0 to 5 percent, and elevation is 4,400 to 5,200 feet. The average annual precipitation is 12 inches. The average annual temperature is 52° F, and the frost-free season is 130 to 160 days. The native vegetation is mainly plains grasses.

In a representative profile the surface layer is light brownish-gray sandy loam about 8 inches thick. The upper part of the subsoil is brown sandy loam about 12 inches thick, and the lower part is pale-brown sandy loam about 10 inches thick. The underlying material is pale-brown sandy loam that extends to a depth of 60 inches or more.

Permeability is rapid, and the available water capacity is high. The surface layer is neutral, and the underlying material is moderately alkaline. The root zone extends to a depth of more than 60 inches. These soils are used for grazing and dryland crops.

Representative profile of Vona sandy loam, in grass, 780 feet west and 10 feet south of the northeast corner of sec. 24, T. 18 S., R. 60 W.

A1—0 to 8 inches, light brownish-gray (10YR 6/2) sandy loam, dark grayish brown (10YR 4/2) when moist; weak, fine, granular structure; soft, very friable; nonsticky and slightly plastic; neutral; clear, smooth boundary.

B21t—8 to 12 inches, brown (10YR 5/3) sandy loam, dark brown (10YR 4/3) when moist; weak, medium, prismatic structure parting to moderate, medium, subangular blocky; slightly hard, very friable; slightly sticky and slightly plastic; thin, patchy clay films on peds; neutral; clear, smooth boundary.

B22t—12 to 20 inches, brown (10YR 5/3) sandy loam, dark brown (10YR 4/3) when moist; moderate, medium, prismatic structure parting to moderate, medium, subangular blocky; hard, friable; slightly sticky and slightly plastic; thin, patchy clay films on peds; neutral; clear, smooth boundary.

B3ca—20 to 30 inches, pale-brown (10YR 6/3) sandy loam, brown (10YR 5/3) when moist; weak, coarse, prismatic structure parting to weak, coarse, subangular blocky; hard, friable; slightly sticky and slightly plastic; strongly calcareous; fine, rounded, soft masses of lime; moderately alkaline; clear, smooth boundary.

C—30 to 60 inches, pale-brown (10YR 6/3) sandy loam, brown (10YR 5/3) when moist; massive; slightly hard, very friable; nonsticky and slightly plastic; calcareous; moderately alkaline.

The A horizon is loamy sand, loamy fine sand, or sandy loam 6 to 18 inches thick. The B2 horizon is 12 to 28 inches thick. The C horizon is loamy fine sand, sandy loam, or fine sandy loam.

Vn—Vona loamy sand. This soil is in the northeastern part of Pueblo County. The slope is 1 to 5 percent. The areas are irregularly shaped and cover as much as 600 acres. This soil has a profile similar to the one described as representative of the series, but the surface layer is loamy sand 12 to 18 inches thick.

Included with this soil in mapping are small areas of Valent soils.

Runoff is slow, and the hazard of erosion is severe.

This soil is better suited to grazing than to other uses. It has potential for wildlife use if the habitat can be improved. The native vegetation is mainly blue grama, sand dropseed, sand sagebrush, buckwheat, and yucca. Capability unit VIe–3, nonirrigated; Sandy Plains range site.

Vo—Vona sandy loam. This soil is mostly in the northeastern part of Pueblo County. The slope is 0 to 3 percent. The areas cover as much as 200 acres or more. This soil has the profile described as representative of the series.

Included with this soil in mapping are small areas of Olney soils; these make up about 15 percent of the acreage.

Runoff is slow. The hazard of water erosion is slight, but the hazard of soil blowing is high.

This soil is better suited to grazing than to other uses. It has potential for wildlife use if the habitat can be improved. Some areas are used for dryland pinto beans and sorghum. The native vegetation is mainly blue grama, sand dropseed, and yucca. Capability unit VIe–3, nonirrigated; Sandy Plains range site.

Vs2—Vona-Otero complex, eroded. This complex is in the northeastern part of the survey area. It is made up of about 60 percent Vona loamy sand, 30 percent Otero sandy loam, and 10 percent Olney sandy loam. These soils are gently undulating and cover areas as large as 80 acres on nonirrigated farmland. In the most severely eroded areas, as much as 5 acres in size, light-colored limy underlying material is exposed.

The Vona and Otero soils in this complex have a profile similar to the one described as representative of their series, but they are eroded and their surface layer varies in thickness.

The hazard of soil blowing is high.

This complex is used for sorghum and beans. It is better suited to grassland than to other uses. The eroded spots of Otero sandy loam produce poor stands of low-vigor plants. Capability unit VIe–3, nonirrigated; Sandy Plains range site.

Wetmore Series

The Wetmore series consists of shallow, well-drained soils. These soils formed on mountainsides in residuum weathered from granite. They are underlain by bedrock at a depth of 10 to 20 inches. The slope is 40 to 65 percent, and elevation is 6,600 to 7,600 feet. The average annual temperature is 45° F, and the frost-free season is 110 to 120 days. The native vegetation is mainly mixed conifers.

In a representative profile the surface layer is gray gravelly coarse sandy loam about 6 inches thick. The subsurface layer is reddish-gray gravelly coarse sandy loam about 6 inches thick. The subsoil is light reddish-brown gravelly coarse sandy loam about 6 inches thick. Hard granite is at a depth of 18 inches.

Permeability is rapid, and the available water capacity is low. The surface layer is neutral, and the subsoil is slightly acid. The root zone extends to a depth of 20 inches or less. These soils are used for forest, recreation, and wildlife habitat.

Representative profile of Wetmore gravelly coarse sandy loam, in an area of Wetmore-Mortenson association, in forest, 0.1 mile east and 0.1 mile south of the northwest corner of sec. 16, T. 21 S., R. 69 W.

O1—2 inches to 0, needles, leaves, and twigs.

A2—0 to 6 inches, gray (10YR 6/1) gravelly coarse sandy loam, dark grayish brown (10YR 4/2) when moist; moderate, medium, granular structure; slightly hard, very friable; nonsticky and slightly plastic; common medium and very fine roots; about 20 percent angular gravel and 10 percent stones; neutral; clear, smooth boundary.

A&B—6 to 12 inches, reddish-gray (5YR 6/2) gravelly coarse sandy loam, dark reddish gray (5YR 4/2) when moist; moderate, medium, granular structure; slightly hard, very friable; nonsticky and slightly plastic; few nodules of sandy clay loam; common medium and very fine roots; about 25 percent angular gravel and 10 percent stones; slightly acid; clear, wavy boundary.

B2t—12 to 18 inches, light reddish-brown (5YR 6/4) gravelly coarse sandy loam, reddish brown (5YR 4/3) when moist; moderate, fine, angular blocky structure; hard, very friable; slightly sticky and plastic; this horizon consists of lamellae and nodules that are heavy coarse sandy loam embedded in a matrix of loamy coarse sand; common medium, fine, and very fine roots; 40 percent angular gravel and 20 percent stones; slightly acid; clear, smooth boundary.

R—18 inches, granite.

In places there is a dark-gray A1 horizon 3 inches thick. The A2 horizon ranges from 4 to 17 inches thick. The B2t horizon is gravelly coarse sandy loam or sandy clay loam 6 to 10 inches thick. It has hue of 5YR or 7.5YR, but in places where schist is the dominant parent rock the hue is 10YR. Depth to bedrock ranges from 10 to 20 inches. The content of coarse fragments of angular gravel and stones ranges from 35 to 60 percent.

WE—Wetmore-Mortenson association. This association is in the western part of the survey area on mountainsides that generally face north. About 40 percent of this association is made up of Wetmore gravelly coarse sand loam, 30 percent is Mortenson very stony fine sandy loam, 20 percent is a soil that is similar to this Wetmore soil but has a 10- to 15-inch layer of weathered granite over the hard granite, and 10 percent consists of other soils. The slope is 25 to 70 percent. The Wetmore soil formed in material weathered from granite and schist, and the Mortenson soil formed in material weathered from sandstone,

but small areas of each soil occur with the other and are underlain by either granite and schist or sandstone.

The Wetmore soil has the profile described as representative of the Wetmore series, but in places it is finer textured. The Mortenson soil also has the profile described as representative of its series, but in places the subsurface layer is thinner.

Included with these soils in mapping are areas of a deep, grayish-brown loamy soil that has slopes of 10 to 25 percent. It is on footslopes at the base of mountainsides along the sides of areas, 100 to 300 feet wide, of a very dark brown, deep, loamy soil that occupies drainageways. The soil included in drainageways has slopes of 3 to 10 percent.

Runoff is medium, and the hazard of erosion is slight.

If they are well managed, these soils have medium potential for wood products. The native vegetation is white fir, Douglas-fir, ponderosa pine, and an understory of shrubs and grasses. Capability unit VIIs–4, nonirrigated; woodland suitability group 5x1; range site not assigned.

Wiley Series

The Wiley series consists of deep, well-drained soils that formed in loess on sandstone uplands. The slope is 1 to 4 percent, and elevation is 4,400 to 5,200 feet. The average annual precipitation is 12 inches. The average annual temperature is 53° F, and the frost-free season is 145 to 175 days. The native vegetation is mainly short plains grasses.

In a representative profile the surface layer is light brownish-gray loam about 6 inches thick. The upper part of the subsoil is pale-brown silty clay loam about 9 inches thick, and the lower part is pale-brown loam about 26 inches thick. Interbedded, weathered sandstone and shale are at a depth of about 50 inches.

Permeability is moderately slow, and the available water capacity is high. The surface layer is neutral to moderately alkaline, and the subsoil and underlying material are moderately alkaline. The root zone extends to a depth of 50 to 60 inches or more. These soils are used for grazing.

Representative profile of Wiley loam, in an area of Wiley-Kim loams, in grass, 0.35 mile south and 0.15 mile west of the northeast corner of sec. 28, T. 26 S., R. 60 W.

A—0 to 6 inches, light brownish-gray (10YR 6/2) loam, dark grayish brown (10YR 4/2) when moist; weak, thick, platy structure parting to weak, fine, granular; soft, very friable; slightly sticky and slightly plastic; calcareous; moderately alkaline; clear, smooth boundary.

B2t—6 to 15 inches, pale-brown (10YR 6/3) silty clay loam, brown (10YR 5/3) when moist; moderate, medium, prismatic structure parting to moderate, medium, subangular blocky; hard, firm; slightly sticky and plastic; thin, patchy, clay films on peds; calcareous; moderately alkaline; clear, smooth boundary.

B3ca—15 to 24 inches, pale-brown (10YR 6/3) loam, brown (10YR 5/3) when moist; hard, friable; slightly sticky and plastic; calcareous; common, small, soft masses of lime; moderately alkaline; clear, smooth boundary.

Ccacs—24 to 50 inches, pale-brown (10YR 6/3) loam, brown (10YR 5/3) when moist; massive; slightly hard, friable; slightly sticky and plastic; calcareous; seams and small soft masses of lime and gypsum; moderately alkaline; clear, smooth boundary.

IIR—50 to 60 inches, weathered shale and sandstone.

The A horizon is loam or silt loam 3 to 7 inches thick. The B2t horizon is silt loam or silty clay loam 3 to 9 inches thick. The C horizon is loam, silt loam, or silty clay loam. Depth to bedrock is 50 to 60 inches or more.

Wk—Wiley-Kim loams. This complex is in the southern and northwestern parts of Pueblo County in irregularly shaped areas that cover as much as 1,000 acres. It is made up of about 60 percent Wiley loam and 25 percent Kim loam. The Wiley soil is on nearly level and very gently undulating uplands. The Kim soil is on sloping low ridges, knolls, and moderately sloping areas at the foot of sandstone or limestone escarpments. Bedrock is generally at a depth of 4 to 6 feet, but in places it is deeper.

The Wiley and Kim soils in this complex have the profile described as representative of their series.

Included with these soils in mapping are areas of Travessilla soils, which make up about 5 percent of the acreage, and areas of Manzanola soils, which make up about 10 percent.

Runoff is medium, and the hazard of erosion is moderate.

This association is better suited to grazing than to other uses, and most of the acreage is used for grazing. The association has potential for wildlife use if the habitat can be improved. The native vegetation is mainly blue grama, galleta, sand dropseed, cane cactus, and yucca. Capability unit VIe–1, nonirrigated; Loamy Plains range site.

Wormser Series

The Wormser series consists of moderately deep, well-drained soils. These soils formed on sandstone uplands in silty loess and loamy residuum weathered from sandstone. They are underlain by sandstone between depths of 20 and 40 inches. The slope is 1 to 4 percent, and elevation is 5,800 to 7,000 feet. The average annual precipitation is 17 inches. The average annual temperature is 50° F, and the frost-free season is 130 to 140 days. The native vegetation is mainly short plains grasses.

In a representative profile the surface layer is grayish-brown silty clay loam and brown clay loam about 16 inches thick, and the lower part is pale-brown clay loam about 5 inches thick. The underlying material is very pale brown clay loam about 8 inches thick. Sandstone is at a depth of about 33 inches.

Permeability is slow, and the available water capacity is moderate. The surface layer is neutral, and the subsoil is moderately alkaline. The root zone extends to a depth of 20 to 40 inches. These soils are used for range, wildlife habitat, and watershed.

Representative profile of Wormser silt loam, in range, 0.3 mile south of the northwest corner of sec. 17, T. 22 S., R. 67 W.

A—0 to 4 inches, grayish-brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) when moist; moderate, fine, granular structure; slightly hard, very friable; slightly sticky and slightly plastic; many very fine roots; neutral; clear, smooth boundary.

B1t—4 to 9 inches, grayish-brown (10YR 5/2) silty clay loam, very dark grayish brown (10YR 3/2) when moist; moderate, fine, subangular blocky structure; hard, friable; sticky and plastic; many very fine roots;

thin, patchy, clay films on peds; neutral; clear, smooth boundary.

B2t—9 to 20 inches, brown (7.5YR 5/4) heavy clay loam, dark brown (7.5YR 4/4) when moist; moderate, coarse, prismatic structure parting to moderate, medium, angular blocky; extremely hard, firm; sticky and very plastic; common very fine roots; thin, continuous, clay films on peds; neutral; clear, smooth boundary.

B3t—20 to 25 inches, pale-brown (10YR 6/3) clay loam, dark brown (10YR 4/3) when moist; moderate, medium, subangular blocky structure parting to moderate, fine, angular blocky; very hard, friable; sticky and plastic; common very fine roots; thin, patchy, clay films on peds; calcareous; fine filaments and threads of lime; moderately alkaline; gradual, smooth boundary.

Cca—25 to 33 inches, very pale brown (10YR 7/4) clay loam, brown (10YR 5/3) when moist; weak, medium, subangular blocky structure; hard, very friable; sticky and plastic; calcareous; moderately alkaline; clear, smooth boundary.

R—33 inches, sandstone.

The A horizon is 3 to 5 inches thick. The A and B horizons are as much as 10 percent small fragments of sandstone, and the Cca is as much as 20 percent fragments. The B2t horizon is clay, clay loam, or silty clay loam. The depth to the Cca horizon ranges from 15 to 25 inches, and the depth to sandstone ranges from 20 to 40 inches.

Wo—Wormser silt loam. This soil is in the western part of the survey area. The slope is 1 to 4 percent. The areas are irregularly shaped and cover as much as 600 acres. Small, barren slickspots scattered throughout the area make up about 15 percent of the acreage.

Included with this soil in mapping are areas of Nunn soils, which make up about 15 percent of the acreage, and areas of Stroupe soils, which make up about 5 percent.

Runoff is medium, and the hazard of erosion is moderate.

This soil is suited to grazing. It has potential for wildlife use if the habitat can be improved. The native vegetation is mainly western wheatgrass, blue grama, alkali sacaton, and cactus. Capability unit VIe–4, nonirrigated; Clayey Foothills range site.

Use and Management of the Soils

In this section the system of capability grouping used by the Soil Conservation Service is described, and the management of the soils in the Pueblo Area is discussed by capability groups. Irrigated capability units and yields of irrigated crops grown on the soils in these units are explained first, followed by the nonirrigated capability units. Management of the soils for woodland, windbreaks, and range is also described. This section also explains how the soils are used for roads, farm ponds, and other engineering structures, and it provides information about managing soils for urban-related uses and for selected recreation use.

Capability Grouping

Capability grouping shows, in a general way, the suitability of soils for most kinds of field crops. The soils are grouped according to their limitations when used for field crops, the risk of damage when they are used, and the way they respond to treatment. The grouping does not take into account major and generally expensive landforming that would change slope, depth, or other characteristics of the soils; does not take into consideration possible but unlikely major reclamation projects; and does not apply to horticultural crops or other crops that require special management.

Those familiar with the capability classification can infer from it much about the behavior of soils when used for other purposes. But this classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for range, for forest trees, or for engineering.

In the capability system, the kinds of soil are grouped at three levels: the capability class, the subclass, and the unit. A survey area may not have soils of all classes. These groups are described in the following paragraphs.

CAPABILITY CLASSES, the broadest groups, are designated by Roman numerals I to VIII. The numerals indicate progressively greater limitations and narrower choices for practical use, defined as follows:

Class I soils have few limitations that restrict their use.

Class II soils have moderate limitations that reduce the choice of plants or require moderate conservation practices.

Class III soils have severe limitations that reduce the choice of plants, require special conservation practices, or both.

Class IV soils have very severe limitations that reduce the choice of plants, require very careful management, or both.

Class V soils are subject to little or no erosion but have other limitations, impractical to remove, that limit their use largely to pasture, range, woodland, or wildlife habitat.

Class VI soils have severe limitations that make them generally unsuited to cultivation and limit their use largely to pasture, range, woodland, or wildlife habitat.

Class VII soils have very severe limitations that make them unsuited to cultivation and that restrict their use largely to pasture, range, woodland, or wildlife habitat.

Class VIII soils and landforms have limitations that preclude their use for commercial plants and restrict their use to recreation, wildlife habitat, water supply, or esthetic purposes.

CAPABILITY SUBCLASSES are soil groups within one class; they are designated by adding a small letter, *e*, *w*, *s*, or *c*, to the class numeral, for example, IIe. The letter *e* shows that the main limitation is risk of erosion; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in only some parts of the United States, shows that the chief limitation is climate that is too cold or too dry.

In class I there are no subclasses, because the soils of this class have few limitations. Class V can contain, at the most, only the subclasses indicated by *w*, *s*, and *c*, because the soils in class V are subject to little or no erosion, although they have other limitations that re-

strict their use largely to pasture, range, woodland, wildlife habitat, or recreation.

CAPABILITY UNITS are soil groups within the subclasses. The soils in one capability unit are enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity and other responses to management. Thus, the capability unit is a convenient grouping for making many statements about management of soils. Capability units are generally designated by adding an Arabic numeral to the subclass symbol, for example, IIe–1 or IIIe–2. Thus, in one symbol, the Roman numeral designates the capability class, or degree of limitation; the small letter indicates the subclass, or kind of limitation, as defined in the foregoing paragraph; and the Arabic numeral specifically identifies the capability unit within each subclass.

In the following pages the capability units are described, and suggestions for the use and management of the soils are given.

Irrigated land

The irrigated soils of the Pueblo Area are in capability classes I, II, and III. About 37,570 acres of the survey area is used for irrigated crops, pasture, and hayland. The irrigation water for most of the acreage is obtained by diverting water from the Arkansas River and Fountain Creek. The diverted water is supplemented by well water from the valley fill aquifer of these streams.

The total irrigated acreage makes up about 2 percent of the survey area. The supply of irrigation water varies from year to year, and storage facilities for water are lacking. The water supply is adequate in most years for irrigation systems that have good water rights. Systems that have poor water rights have a limited supply of irrigation water and do little more than supplement the natural precipitation.

The irrigated soils are used for field crops, vegetable crops, and grasses and legumes for hay and pasture. The principal crops are alfalfa and corn and sorghum for grain. Near the city of Pueblo a wide variety of vegetable crops is grown and marketed locally.

Irrigation water is delivered to fields in ditches. Row crops are irrigated mainly by the furrow method. The border, corrugation, and contour ditch methods are used to irrigate drilled and close-growing crops.

The highest crop production and fewest management problems occur in the Rocky Ford association. These soils are well suited to irrigation farming. Maintaining fertility and tilth and using irrigation water efficiently are the main concerns of management.

Management problems of irrigated soils in the Las Animas-Glenberg-Apishapa association are greater. The clayey soils are difficult to till and have a low water-infiltration rate. These soils are moderately to strongly affected by saline or alkali salts, or both. Salts tend to accumulate in soils that are not well drained. Soil suitability and problems in management are further discussed in the following capability units for irrigated land.

CAPABILITY UNIT I, IRRIGATED

This unit consists of deep, well-drained soils that have a surface layer of silty clay loam, clay loam, silt loam, or sandy loam and a subsoil or underlying material of silty clay loam, silt loam, loam, or sandy loam. The slope is 0 to 2 percent. The average annual precipitation is 12 inches, and the frost-free season is 145 to 175 days.

Permeability is moderately slow to moderately rapid, and the available water capacity is mostly high. Runoff is slow. The hazards of soil blowing and erosion are slight.

The soils in this unit are suited to all climatically adapted cultivated crops, and most soils are used for crops. They are also suited to less intensive uses, such as irrigated pasture and hayland.

Maintaining fertility and tilth are the only concerns of management. Such conservation practices as turning under crop residue, managing irrigation water, and applying fertilizer according to soil tests and crop needs help maintain fertility and tilth.

CAPABILITY UNIT IIe-1, IRRIGATED

This unit consists of deep, well-drained soils that have a surface layer of fine sandy loam, loam, silt loam, silty clay loam, or clay loam and a subsoil and substratum of sandy loam, fine sandy loam, loam, or silt loam. The slope is 0 to 3 percent. The average annual precipitation is 12 inches, and the frost-free season is generally 145 to 175 days. In the Pueblo Area some soils in this unit receive about 18 inches of precipitation annually and have a frost-free season of 115 to 145 days, but their use and management are essentially the same under irrigation.

Permeability is slow to moderately rapid, and the available water capacity is high or moderate. Runoff is slow or medium. The hazard of erosion is moderate or slight.

The soils in this unit are suited to climatically adapted cultivated crops, such as corn, grain sorghum, wheat, sugar beets, beans, alfalfa, and pasture. Row crops can be grown year after year, but this practice subjects the soil to the greatest hazard of erosion.

Controlling erosion, protecting the soils from light flooding, and maintaining soil tilth and continuing high levels of production are the major concerns of management. Returning crop residue to the soil helps maintain the supply of organic matter in the soil, which improves soil tilth, increases the water intake rate, and helps control erosion. Additional sources of organic matter are green-manure crops and barnyard manure. Minimum tillage helps maintain soil tilth and reduces the hazard of erosion. Fertilizer should be applied in amounts determined by soil fertility tests and crop needs.

Suitable irrigation methods are furrows, corrugations, and contour ditches. Hand leveling generally improves the distribution of irrigation water. Border irrigation is suitable on well-leveled land. Cross-slope irrigation for row crops is helpful.

CAPABILITY UNIT IIw-1, IRRIGATED

This unit consists of deep, well-drained soils that have a surface layer of silty clay loam or silt loam and an underlying material of silt loam or silty clay loam. The slope is 0 to 2 percent. The average annual precipi-

tation is 12 inches, and the frost-free season is 145 to 175 days.

Permeability is moderate, and the available water capacity is high. The hazards of soil blowing and erosion are low. The soil is occasionally flooded.

The soils in this unit are suited to climatically adapted cultivated crops and hay and pasture, except for those crops that are not salt tolerant. These soils can be cultivated, but poor drainage and the accumulated salts can damage some crops. Row crops can be grown year after year, but intense cultivation can result in a compacted layer below the surface layer.

Maintaining soil tilth and fertility and preventing additional salt accumulation are the major concerns of management. Chiseling or subsoiling every 5 or 6 years just before seeding to alfalfa helps reduce compaction. Minimum tillage helps maintain tilth and reduce compaction. Growing green-manure crops, turning under crop residue, and adding barnyard manure help maintain the supply of organic matter in the soil, which improves soil tilth and increases the water intake rate.

Suitable irrigation methods are borders, furrows, and corrugations. Well-leveled land is needed for border irrigation. Drainage is needed in places. Low dikes protect the soils from flooding.

CAPABILITY UNIT IIIe-1, IRRIGATED

This unit consists of deep, well-drained soils that have a surface layer of sandy loam or gravelly sandy loam and a subsoil of sandy loam. The slope is 1 to 9 percent. The average annual precipitation is 12 inches, and the frost-free season is 145 to 175 days.

Permeability is moderate to rapid, and the available water capacity is moderate. Runoff is slow or medium. The hazard of erosion is moderate, and the hazard of soil blowing is high.

The soils in this unit are suited to climatically adapted cultivated crops, to close-growing crops, and to hay and pasture. Alfalfa grows well on these soils, making good use of the limited supply of irrigation water. Stands remain dense for 4 years or more, providing good erosion control. Tall and intermediate grasses withstand drought and provide good erosion control in areas where the supply of irrigation water is limited.

Controlling soil blowing and erosion and maintaining soil fertility are the major concerns of management. Returning crop residue to the soil and growing a winter cover crop help control erosion and maintain the supply of organic material in the soil. Fertilizer should be applied according to the results of soil tests and the needs of the crop.

Contour ditches, furrows, or corrugations can be used in irrigation, but the runs need to be short because the intake rate of the soils is rapid. These soils need frequent, light irrigations. Cross-slope irrigation can be used where the soils are leveled to a single slope.

CAPABILITY UNIT IIIe-2, IRRIGATED

This unit consists of deep, well-drained soils that have a surface layer of silt loam or silty clay loam and a subsoil of silt loam or silty clay. The slope is 1 to 5 percent. The average annual precipitation is 12 inches, and the frost-free season is 145 to 175 days.

Permeability is moderately slow or slow, and the available water capacity is high. Runoff is medium or rapid. The hazard of erosion is moderate or high, and the hazard of soil blowing is moderate.

The soils in this unit are suited to all climatically adapted cultivated crops and to hay and pasture. Corn, sorghum, small grain, pasture, and alfalfa grow well on these soils.

Controlling water erosion and maintaining soil fertility and tilth are the major concerns of management. Close-growing crops provide good erosion control. Turning under crop residue and growing green-manure crops help maintain the supply of organic matter in the soil, which improves soil tilth, increases the water intake rate, and reduces erosion. Fertilizer should be applied in amounts determined by soil fertility tests and crop needs.

Suitable irrigation methods are furrows, contour ditches, and corrugations. Land leveling improves the application of irrigation water. Cross-slope irrigation can be used where the soils are leveled to a single slope. Length of runs and irrigation water heads must be regulated carefully to reduce erosion and insure the proper depth of soil wetting.

CAPABILITY UNIT IIIw-1, IRRIGATED

This unit consists of deep, somewhat poorly drained soils that have a surface layer of silty clay or silty loam and a subsoil of silty clay or silt loam. The slope is 0 to 2 percent. The average annual precipitation is 12 inches, and the frost-free season is 145 to 175 days.

Permeability is slow or moderate, and the available water capacity is high. Runoff is slow. The hazard of erosion is slight or moderate. The soils contain a low to moderate amount of saline or alkali salts, or both.

The soils in this unit are suited to climatically adapted cultivated crops that have a medium or high salt tolerance. They are also suited to less intensive uses, such as irrigated pasture. Tall wheatgrass grows well on these soils.

These soils are difficult to drain, and excess salts do not leach easily. The soils are occasionally flooded. Such conservation practices as turning under crop residue, drainage, managing irrigation water, and reducing the content of toxic salts increase crop production and help to control erosion. Growing green-manure crops and chiseling and subsoiling help maintain soil tilth and help prevent the formation of a tillage pan. Low dikes protect the soils from flooding.

CAPABILITY UNIT IIIw-2, IRRIGATED

Only Las Animas fine sandy loam is in this unit. It is a deep, somewhat poorly drained soil that has a surface layer and subsoil of fine sandy loam. The slope is 0 to 2 percent. The average annual precipitation is 12 inches, and the frost-free season is 145 to 175 days.

Permeability is moderately rapid, and the available water capacity is high. Runoff is slow. The hazard of soil blowing is high, and the hazard of water erosion is slight.

The soil in this unit is suited to climatically adapted cultivated crops that have a medium or high salt tolerance. It is also suited to less intensive uses, such

as irrigated pasture. It is not well suited to deep-rooted crops because of the water table.

This soil is difficult to drain, and excess salts are not easy to remove. The soil does not have a suitable drainage outlet and is frequently flooded. Such conservation practices as drainage, management of irrigation water, reduction of the content of toxic salts, turning under crop residue, and growing a cover crop help protect the soil from erosion and help maintain the soil in good condition for good plant growth. Low dikes protect the soil from flooding.

CAPABILITY UNIT IIIs-1, IRRIGATED

Only Limon silty clay, 0 to 2 percent slopes, is in this unit. It is a deep, well-drained soil. The average annual precipitation is 12 inches, and the frost-free season is 145 to 175 days.

Permeability is slow, and the available water capacity is high. Runoff is slow. The hazards of soil blowing and erosion are moderate.

This soil is suited to salt-tolerant crops. They are used for sorghum, corn, small grain, alfalfa, and pasture. Tall and intermediate wheatgrass grow well and can withstand limited periods of drought when there is no irrigation water. Continuous row cropping should be avoided and tillage operations reduced to a minimum to avoid the formation of a tillage pan. A good crop rotation includes grass, alfalfa, or other close-growing crops one-fourth to one-half of the time and row crops no more than 2 to 3 consecutive years.

Poor tilth and slow permeability are the main concerns of management. Chiseling and subsoiling before planting alfalfa helps prevent the formation of a tillage pan and improves the water intake rate and soil permeability. Growing green-manure crops and turning under crop residue increases the supply of organic matter in the soil, which improves tilth and increases the water intake rate. Fertilizer should be applied in amounts determined by the results of soil tests and the needs of the crop.

Suitable irrigation methods are furrows, corrugations, and borders. Irrigation runs can be relatively long. Land leveling is needed in places.

Nonirrigated land

The nonirrigated soils of the Pueblo Area are in capability classes III, IV, VI, and VII. Most of the acreage is used for range.

About 94,280 acres in the Pueblo Area is dryfarmed. About 60 percent of the dryfarmed soils are in the Olney-Vona association in the northeastern part of Pueblo County and are in capability class IV. The hazard of erosion is high, mainly from soil blowing. Farmed land may not have an adequate ground cover because the climate is dry. Dryfarming practices that help control soil blowing are the most successful. Effective practices include wind stripping, blank listing, stubble mulching, and managing crop residue. Emergency tillage is sometimes necessary during the season of high winds, from January to April. Blank listing at right angles to the prevailing wind is an effective control. Applying a small amount of nitrogen fertilizer often improves yields and increases crop residue.

About 30 percent of the dryfarmed soils are in the Nunn-Stroupe-Holderness association in the western part of the survey area and are in capability classes III and IV. The hazard of erosion is slight to moderate, depending on the kind of soil. The climate is dry, and the plant cover may not be adequate to protect the soils from erosion. Among the effective dryfarming practices are a suitable cropping system, contour farming, stubble mulching, field stripcropping, and parallel terracing.

About 10 percent of the dryfarmed acreage is in the Manvel association and is in capability class VI.

Soil suitability and concerns of management are described in the following nonirrigated capability units. For information on range management, see the section "Range."

CAPABILITY UNIT IIIe-1, NONIRRIGATED

This unit consists of deep, well-drained soils that have a surface layer of clay loam and a subsoil of heavy clay loam. Also in this unit are some soils that have a surface layer of loam and a subsoil of silt loam, but they cover only a small acreage. The slope is 0 to 5 percent. The average annual precipitation is 16 to 18 inches, and the frost-free season is 115 to 145 days.

Permeability is mostly slow, and the available water capacity is high. Runoff is medium or slow. The hazard of soil blowing is slight, and the hazard of water erosion is moderate.

The soils in this unit are well suited to small grain, grass pasture, and range. Conserving soil moisture and controlling erosion are the main concerns of management. Such conservation practices as returning crop residue to the soil, contour or field stripcropping, stubble mulching, and terracing help control erosion, increase the water intake rate, and maintain good growth.

CAPABILITY UNIT IVe-1, NONIRRIGATED

The only soil in this unit is Baca silty clay loam. It is a deep, well-drained soil that has a subsoil of heavy silty clay loam. The slope is 0 to 2 percent. The average annual precipitation is 12 to 16 inches, and the frost-free season is 145 to 175 days.

Permeability is moderately slow, and the available water capacity is high. Runoff is slow. The hazard of water erosion is slight, and that of soil blowing is moderate.

The soil in this unit is suited to grain crops, grass pasture, and range. Conserving soil moisture and controlling soil blowing are the main concerns of management. Such conservation practices as stubble mulching and wind stripcropping help control erosion and maintain good growth.

CAPABILITY UNIT IVe-2, NONIRRIGATED

This unit consists of deep, well-drained soils that have a surface layer of loamy sand to sandy loam and a subsoil of sandy clay loam. The slope is 0 to 3 percent. The average annual precipitation is 12 inches, and the frost-free season is 130 to 160 days.

Permeability is moderate, and the available water capacity is high. Runoff is slow. The hazard of soil

blowing is high, and the hazard of water erosion is low.

The soils in this unit are suited to grain, feed crops, grass pasture, and range. Conserving soil moisture and controlling soil blowing are the main concerns of management. Such conservation practices as stubble mulching, wind stripcropping, and cover cropping help control erosion and maintain good growth. At times emergency tillage, such as blank listing, is needed to control soil blowing.

CAPABILITY UNIT IVe-3, NONIRRIGATED

This unit consists of deep, well-drained soils that have a surface layer of loam, stony loam, silt loam, or clay loam and a subsoil of heavy clay loam. The slope is 3 to 12 percent. The average annual precipitation is 16 to 18 inches, and the frost-free season is 100 to 145 days.

Permeability is slow, and the available water capacity is high. Runoff is medium. The hazard of soil blowing and that of water erosion is slight or moderate.

The soils in this unit are suited to small grain, alfalfa, grass pasture, and range. Conserving soil moisture and controlling erosion are the main concerns of management. Such conservation practices as contour farming, using crop residue, and terracing help control erosion, increase the water intake rate, and maintain good growth.

CAPABILITY UNIT VIe-1, NONIRRIGATED

This unit consists of deep and moderately deep, well-drained soils that have a subsoil or underlying material of fine sandy loam, loam, silt loam, or clay loam. The slope is 0 to 5 percent. The average annual precipitation is 12 inches, and the frost-free season is 130 to 175 days.

Permeability is moderately rapid to slow, and the available water capacity is moderate in the moderately deep Minnequa soils and high in the rest. Runoff is medium or slow. The hazards of soil blowing and water erosion are moderate in most places, but that of soil blowing is high in some places.

The soils in this unit are suited to grazing. The main concern of management is to maintain the vegetation in good to excellent range condition so that runoff is slow or medium and erosion is reduced to a minimum. Such conservation practices as proper grazing use, deferred grazing, and rotation grazing permit plants to gain and maintain plant vigor, increase plant litter, and encourage plant reproduction. Mechanical practices and range seeding are feasible on these soils where the range is in poor condition.

CAPABILITY UNIT VIe-2, NONIRRIGATED

This unit consists of deep and moderately deep, well-drained soils that have a surface layer of loamy sand, sandy loam, clay loam, silty clay loam, or silty clay and a subsoil of sandy clay loam, clay loam, silty clay loam, silty clay, or clay. The slope is 0 to 9 percent. The average annual precipitation is 12 inches, and the frost-free season is 145 to 175 days.

Permeability is slow or very slow, and the available water capacity is low in the moderately deep Razor soils and high in the rest. Runoff is medium or slow. The hazards of soil blowing and water erosion are moderate or high.

The soils in this unit are suited to grazing. The main concern of management is to maintain the vegetation in good to excellent range condition and reduce erosion. Once the range is in poor condition and the soils are eroding, it is very difficult to improve the range vegetation because of the slow permeability and slow water intake rate of these soils. Such conservation practices as deferred grazing, rotation grazing, and proper grazing use help maintain plant vigor and encourage the accumulation of plant litter, which helps reduce runoff. Mechanical practices, erosion control dams, and diversions can be useful in controlling gully erosion and reducing runoff. Range seeding of badly deteriorated areas can be done when soil moisture conditions are favorable.

CAPABILITY UNIT VIe-3, NONIRRIGATED

This unit consists of deep, well-drained to somewhat excessively drained soils that have a surface layer of loamy sand or sandy loam and a subsoil of fine sand, gravelly sandy loam, sandy loam, sandy clay loam, or loam. The slope is 0 to 9 percent. The average annual precipitation is 12 inches, and the frost-free season is 130 to 175 days.

Permeability is rapid to moderate, and the available water capacity is low to high. Runoff is medium or slow. The hazard of soil blowing is moderate or high, and the hazard of water erosion is slight to high.

The soils in this unit are suited to grazing. Some areas are dryfarmed. Controlling soil blowing and maintaining the range vegetation in good to excellent condition are the main concerns of management. Such conservation practices as deferred grazing, rotation grazing, and proper grazing use help improve or maintain plant vigor and the plant cover, increase plant litter, and protect the soil and at the same time maintain or improve the quantity and quality of the vegetation. Eroded cultivated land or range vegetation in poor condition should be reseeded to adapted perennial species. Brush management may be needed on range of excessive brush species where the understory of grasses and forbs is adequate to respond.

CAPABILITY UNIT VIe-4, NONIRRIGATED

This unit consists of deep or moderately deep, well-drained soils that have a surface layer of silt loam or clay loam and a subsoil of clay loam. The slope is 1 to 9 percent. The average annual precipitation is 17 inches, and the frost-free season is 115 to 145 days.

Permeability is slow, and the available water capacity is moderate or high. Runoff is medium or rapid. The hazard of soil blowing is slight or moderate, and the hazard of erosion is moderate.

The soils in this unit are suited to grazing. The main concern of management is controlling erosion. Such practices as proper grazing use, rotation grazing, and deferred grazing reduce erosion by improving plant vigor and increasing plant cover and litter. Such mechanical practices as waterspreading and chiseling are beneficial in some areas to improve the water intake rate. Range seeding, where needed, is possible. Brush

management can be used on areas that have excessive brush if the understory of grasses and forbs is adequate.

CAPABILITY UNIT VIe-5, NONIRRIGATED

The only soil in this unit is Larkson stony loam, 5 to 20 percent slopes. It is a deep, well-drained soil that has a subsoil of clay loam. The slope is 5 to 20 percent. The average annual precipitation is 18 inches, and the frost-free season is 100 to 135 days.

Permeability is slow, and the available water capacity is high. Runoff is medium. The hazard of soil blowing is slight, and the hazard of erosion is high.

This soil is suited to timber and grazing. The main concern of management is reducing runoff and erosion. This can be accomplished by proper grazing use, rotation grazing, deferred grazing of the woodland understory, and woodland improvement.

CAPABILITY UNIT VIw-1, NONIRRIGATED

This unit consists of deep, somewhat poorly drained or moderately well drained soils that have a surface layer of loamy sand, fine sandy loam, silt loam, or silty clay and a subsoil of silt loam, fine sandy loam, silty clay loam, sandy clay loam, silty clay, or clay. The slope is 0 to 4 percent. The average annual precipitation is 12 inches, and the frost-free season is 145 to 175 days.

Permeability is mostly slow or moderately slow, but it is moderately rapid in some of the soils. The available water capacity is high. Runoff is slow. The hazard of soil blowing is mostly slight or medium, but it is high on the loamy sands and fine sandy loams. The hazard of water erosion is slight. Most of the soils in this unit are occasionally flooded. They contain saline or alkali salts, or both.

The soils in this unit are suited to grazing. The main concern of management is to increase the yield and palatability of the forage. Some areas are suited to seeding adapted pasture and hay species. Increased production and improvement of the vegetation are possible through rotation grazing, deferred grazing, and proper grazing use. These practices help maintain good growth, increase the plant cover and the amount of plant litter, and control erosion.

CAPABILITY UNIT VIw-2, NONIRRIGATED

This unit consists mostly of deep, somewhat excessively drained to moderately well drained soils that generally have a surface layer of fine sandy loam, silt loam, or silty clay loam and a subsoil of fine sandy loam, silt loam, or heavy silty clay loam. Some of the soils in this unit have a surface layer and subsoil of sand. The slope is 0 to 2 percent. The average annual precipitation is 12 inches, and the frost-free season is 145 to 175 days.

Permeability is mostly moderately rapid, moderate, or moderately slow. Runoff is slow. The hazard of soil blowing is slight or moderate. The hazard of water erosion is slight. The soils are occasionally or frequently flooded.

The soils in this unit are suited to grazing. Improving the vigor of the vegetation, increasing the plant cover, and maintaining good growth are the main concerns of management. Some areas are suitable for seeding pasture and hay. Water spreading is suitable in some areas. Proper grazing use, rotation grazing, and deferred grazing improve plant vigor, cover, and litter and improve the quality and growth of the vegetation.

CAPABILITY UNIT VIIe-1, NONIRRIGATED

This unit consists of deep, well-drained, severely gullied soils that have a surface layer of silt loam, silty clay loam, or silty clay and a subsoil of silt loam or silty clay. The slope is 0 to 5 percent. The average annual precipitation is 12 inches, and the frost-free season is 145 to 175 days.

Permeability is slow or moderately slow, and the available water capacity is high. Runoff is medium or rapid. The hazard of soil blowing and erosion is moderate.

The soils in this unit are not well suited to grazing in their present condition. Range vegetation is in poor condition, and gully erosion is active. Such practices as check dams, diversions, range seeding, mechanical treatment, deferred grazing, and fencing help control erosion and establish the plant cover.

CAPABILITY UNIT VIIs-1, NONIRRIGATED

This unit consists of shallow, well-drained soils that have a surface layer of silty clay or silty clay loam and are underlain by shale at a depth of 20 inches or less. The slope is 1 to 9 percent. The average annual precipitation is 12 inches, and the frost-free season is 145 to 175 days.

Permeability is slow, moderately slow, or moderate. The available water capacity is low or very low. Runoff is medium or rapid. The hazard of erosion is slight to high.

The soils in this unit are suited to grazing. The main concerns of management are maintaining plant vigor and the plant cover and reducing runoff. Deferred grazing, rotation grazing, and proper grazing use help maintain and improve plant litter, plant vigor, and plant cover.

CAPABILITY UNIT VIIs-2, NONIRRIGATED

This unit consists mostly of deep, somewhat excessively drained or excessively drained soils that have a surface layer of gravelly or very gravelly sandy loam and a subsoil of very gravelly loamy sand or sand. The slope is 5 to 25 percent. The average annual precipitation is 12 inches, and the frost-free season is 130 to 175 days.

Permeability is rapid or very rapid, and the available water capacity is low. Runoff is rapid or moderately slow. The hazard of soil blowing is slight, and the hazard of water erosion is moderate.

The soils in this unit are suited to grazing. Because of the steepness and the size and shape of the areas, management is difficult. The soils are suited to wildlife habitat if the habitat can be improved. Such conservation practices as proper grazing use, rotation grazing, deferred grazing, and fencing help improve and maintain the plant cover. If the soils were used for wildlife habitat, a water supply would be needed.

CAPABILITY UNIT VIIs-3, NONIRRIGATED

This unit consists of shallow, moderately deep and deep, well-drained or somewhat excessively drained soils that have a surface layer of channery loam, extremely stony loam, stony sandy loam, or sandy loam. These soils have a subsoil of very stony clay loam or gravelly sandy loam, or they are underlain by hard rock at a depth of 20 inches or less. The slope ranges from 1 to 90 percent. The average annual precipitation is 12 to 18 inches, and the frost-free season is 110 to 175 days.

Permeability is moderately rapid to slow, and the available water capacity is moderate to very low. Runoff is medium or high. The hazard of soil blowing is low, and the hazard of water erosion is moderate or high.

The soils in this unit are suited to grazing, but management is difficult because of the steepness, stones, and outcrops of rock. The soils are also suited to wildlife habitat if the habitat can be improved. Such conservation practices as proper grazing use, rotation grazing, and deferred grazing improve and maintain plant vigor, the plant cover, and plant litter, which helps reduce runoff and erosion. Springs and other water developments and fencing are a part of good range management and improve the wildlife habitat.

CAPABILITY UNIT VIIs-4, NONIRRIGATED

This unit consists of shallow or deep, well-drained soils that mostly have a surface layer of very stony sandy loam, gravelly coarse sandy loam, or very stony loam and a subsoil of stony or very stony sandy loam or clay loam. Some of these soils are underlain by bedrock at a depth of 20 inches or less. The average annual precipitation is 20 inches, and the frost-free season is 90 to 125 days.

Permeability is slow to rapid, and the available water capacity is high to very low. Runoff is medium. The hazard of soil blowing is slight, and the hazard of water erosion is moderate or slight.

The soils in this unit are suited to timber and grazing. Grazing management is difficult because of the steep slopes, stones, and outcrops of rock. Deferred grazing, rotation grazing, and proper grazing use help maintain or improve plant vigor, the plant cover, and vegetation growth, which helps improve the range condition and reduce erosion. Thinning trees, shrubs, and vines increases timber yield.

Predicted Yields

Table 2 shows predicted yields per acre for the principal crops grown in the survey area.

Irrigated crops.—The predictions for these crops are based on yield records of the Arkansas Valley Branch Experiment Station at Rocky Ford and yield records for sugar beets obtained from the sugar company and from individual farmers. The crops shown for Rocky Ford silty clay loam, 0 to 1 percent slopes, were grown at the experiment station. The yield predictions for other soils were adjusted on the basis of experiment station records, knowledge of soil characteristics and qualities, and interviews with individual farmers.

The yield predictions for irrigated crops in columns A are those that can be expected under an average level of management. Such management includes adequate fertilization for sugar beets; irrigation water applied carefully when available and in amounts estimated to be sufficient; land leveling where urgently needed; and growing various crops in sequence but not in a planned rotation.

The yield predictions in columns B can be expected if a high level of management is used. A high level of management for irrigated crops includes the use of a crop rotation in which alfalfa or grass is maintained a minimum of 3 years, the keeping of the number of tillage operations to a minimum so that soil tilth is maintained, the application of fertilizer in amounts determined by the results of soil tests and the needs of the crop, the proper management of irrigation water, the choice of certified seed sown in a well-prepared bed, the control of weeds and insects, and the completion of all cultural practices at the right time. A reliable water supply is assumed.

Nonirrigated crops.—Predicted yields shown at the end of table 2 for nonirrigated crops are for the two principal soils that are suited to dry farming. These soils are Olney sandy loam, which is in the northeastern part of Pueblo County, and Nunn clay loam, which is in the western part of the survey area. The yields shown are only for wheat, grain sorghum, and pinto beans. These predictions are based mainly on information obtained from farmers, from the Agriculture Stabilization and Conservation Service, and from farm workers familiar with the soils and the crops.

The yield predictions for nonirrigated crops in columns A and are those that can be expected under an average level of management. They are not so high as yields under a high level of management. Average management for these crops does not include a planned cropping system or such management practices as summer fallow, application of fertilizer, control of weeds, control of erosion, the use of certified seed.

A high level of management, shown in columns B, includes a planned cropping system and management practices. The cropping system commonly used is wheat one third of the time, grain sorghum (for feed) one-third of the time, and fallow one-third of the time. Among the management practices used are timely tillage, adequate applications of fertilizer, maintenance of sufficient stubble on the surface to control erosion, and use of certified seed of the best varieties. During years of above average precipitation, yields are as much as 20 percent higher than those under average management.

Range[2]

This section of the soil survey describes the range sites in the Pueblo Area. About 72 percent, or 1,099,490 acres, of the survey area is range.

Soils that have the capacity to produce the same kinds, amounts, and proportions of range plants are grouped into range sites. A range site is the product

[2] By EDWARD C. DENNIS, range conservationist, Soil Conservation Service.

TABLE 2.—*Predicted average yields per acre*

[Yields in columns A are those obtained under an average level of management; yields in columns B are those obtained under a high level of management. Absence of a figure indicates that the crop commonly is not grown on the soil]

Soil	Corn		Wheat		Sugar beets		Grain sorghum		Dry beans (pinto)		Alfalfa	
	A	B	A	B	A	B	A	B	A	B	A	B
	Bu	*Bu*	*Bu*	*Bu*	*Tons*	*Tons*	*Bu*	*Bu*	*Cwt*	*Cwt*	*Tons*	*Tons*
Irrigated areas of—												
Apishapa silty clay	55	70	35	45	12	16	50	68	8	10	2	3½
Baca silty clay loam	55	90	45	65	----	----	50	75	12	18	3	5
Bankard sand	25	45	20	33	----	----	25	50	5	15	1½	2½
Bloom silt loam	15	45	15	30	----	----	20	50	----	----	1½	2½
Glenberg-Haverson fine sandy loams	55	90	27	45	11	16	54	81	12	18	2½	4
Las Animas fine sandy loam	30	50	----	----	----	----	30	50	----	----	1½	3
Limon silty clay, 0 to 2 percent slopes	60	90	40	60	13	19	55	80	10	15	3	5
Limon silty clay loam, 0 to 2 percent slopes	45	80	40	60	12	17	45	80	8	11	2½	4
Manvel silt loam, 0 to 1 percent slopes	70	90	45	55	13	18	65	90	12	18	2½	4½
Manvel silt loam, 1 to 5 percent slopes	60	80	40	50	12	17	60	90	10	18	2	4½
Otero clay loam, 0 to 1 percent slopes	80	110	42	60	14	18	75	90	15	25	4½	6
Otero clay loam, 1 to 3 percent slopes	70	100	35	55	12	18	65	85	14	20	4	6
Otero sandy loam, 0 to 1 percent slopes	50	100	30	55	13	18	60	85	14	20	4	6
Rocky Ford silty clay loam, 0 to 1 percent slopes	85	120	35	60	16	22	75	105	16	21	4½	6
Rocky Ford silty clay loam, 1 to 3 percent slopes	80	120	35	60	14	20	70	100	15	20	4	6
Rocky Ford silty clay loam, wet	85	110	38	55	15	22	76	99	8	12	3	6
Nonirrigated areas of—												
Nunn clay loam, 0 to 5 percent slopes	----	----	20	26	----	----	18	27	----	----	----	----
Olney sandy loam	----	----	----	----	----	----	15	18	280	350	----	----

of all environmental factors responsible for its development.

A plant community existing within a range site that has not undergone abnormal disturbance is the potential or climax plant community for that site. Climax plant communities are not precise or fixed in their composition but vary, within reasonable limits, from year to year and from place to place.

Abnormal disturbance, such as overgrazing, or excessive burning, erosion, or plowing, results in changes in the climax plant community or even complete destruction if the disturbance is drastic enough. If the range site has not deteriorated significantly under such disturbance, secondary plant succession progresses in the direction of the natural potential, or climax, plant community for the site.

Four range condition classes are used to indicate the degree of departure from the potential, or climax, vegetation brought about by grazing or other uses. The classes show the present condition of the native vegetation on a range site in relation to the native vegetation that could grow there.

A range is in *excellent* condition if 76 to 100 percent of the vegetation is of the same kind as that in the climax stand. It is in *good* condition if the percentage is 51 to 75; in *fair* condition if the percentage is 26 to 50; and in *poor* condition if the percentage is 25 or less.

When changes occur in the climax plant community because of use by livestock or disturbance, some plant species increase and others decrease. The species that increase or decrease depends on the grazing animal, the season of use, and the degree of utilization. By comparing the composition of the present plant community to the potential plant community, it is possible to see how individual species have increased and others decreased. Plants not present in the climax community that show up in the present plant community are invaders for the site (*4*).

The composition of the climax and present plant communities, together with other range site information, provide the basis for selecting range management systems. Management programs on range usually try to increase the desirable plants and restore range to as near climax condition as possible. Some programs

are designed to create or maintain plant communities somewhat removed from the climax to fit specific needs in the grazing program, to provide for wildlife habitat, or for other benefits. Any management objective should be compatible with conservation objectives.

In the following pages the 18 range sites in the Pueblo Area are briefly described, and the principal climax plants on the sites are named. The potential annual yield is estimated, in terms of excellent condition unless otherwise identified, for favorable and unfavorable seasons. These yields are expressed as the normal high and low rather than the extremes. Yields are the total annual yield in pounds of air-dry herbage per acre, which includes the current year's growth of leaves, stems, twigs, and fruit of all plants on the site. Not all of this herbage is usable by livestock. The soils in each site can be determined by referring to the "Guide to Mapping Units" at the back of this survey.

ALKALINE PLAINS RANGE SITE

This range site is made up of slowly permeable to very slowly permeable soils that have a surface layer of loamy fine sand, sandy loam, silt loam, clay loam, silty clay loam, or clay. The slope is 1 to 5 percent. The available water capacity is low to high. The average annual precipitation is 12 inches, and most of the precipitation falls during thunderstorms that occur from April to September. The strongly alkaline subsoil largely determines the kind and amount of vegetation produced on these soils.

The approximate potential plant community is made up of 40 percent alkali sacaton, 20 percent blue grama, 15 percent galleta, 10 percent bottlebrush squirreltail, 5 percent saltgrass, 5 percent western wheatgrass, 2 percent low rabbitbrush, 1 percent Fremont goldenweed, 1 percent twogrooved milkvetch, and 1 percent fourwing saltbush.

If the site is in excellent condition, the total annual yield is about 1,500 pounds of air dry herbage per acre in years of favorable moisture and 1,000 pounds per acre in other years. Of this, about 90 percent is from plants that provide forage for cattle.

If this site is heavily grazed for a long period of years, alkali sacaton, blue grama, and squirreltail decrease or disappear and are replaced by saltgrass and galleta. Continued heavy grazing or further depletion permits the invasion of annual forbs, greasewood, and cactus.

CLAYEY FOOTHILLS RANGE SITE

This range site is made up of slowly permeable soils that have a surface layer of clay loam or silt loam. The slope is 1 to 9 percent. The available water capacity is moderate to high. The annual precipitation is about 17 inches, and most of the precipitation falls during thunderstorms in the period April to September. The clayey surface layer and moderate depth to bedrock largely determine the kind and amount of vegetation produced on these soils.

The approximate potential plant community is made up of about 30 percent western wheatgrass, 15 percent needleandthread, 15 percent side-oats grama, 10 percent little bluestem, 10 percent big bluestem, 5 percent mountain muhly, 5 percent Arizona fescue, 5 percent low rabbitbrush, and 5 percent other plants.

If the site is in excellent condition, the total annual yield is about 800 pounds of air-dry herbage per acre in years of favorable moisture and 600 pounds per acre in other years. Of this, about 85 percent is from plants that provide forage for cattle.

If this site is heavily grazed for a long period of years, the bluestems, needleandthread, and western wheatgrass decrease or disappear and are replaced by blue grama, three-awn, and bluegrass. Continued heavy grazing or further depletion of the vegetation permits the invasion of annual weeds, pinyon, juniper, sleepygrass, bluegrass, pricklypear, and hairy goldenaster.

COBBLY FOOTHILLS RANGE SITE

This range site is made up of moderately permeable soils that have a surface layer of stony sandy loam. The slope is 9 to 25 percent. The available water capacity is low. The annual precipitation is about 16 inches, and most of the precipitation falls during thunderstorms in the period April to September. The stony sandy loam surface layer affects the kind and amount of vegetation produced on these soils.

The approximate potential plant community is made up of 15 percent mountain muhly, 10 percent blue grama, 10 percent big bluestem, 10 percent little bluestem, 7 percent prairie junegrass, 6 percent side-oats grama, 5 percent western wheatgrass, and 37 percent other plants.

If the site is in excellent condition, the total annual yield is about 2,500 pounds of air-dry herbage per acre in years of favorable moisture and 1,500 pounds per acre in other years. Of this, about 85 percent is from plants that provide forage for cattle.

If this site is heavily grazed for a long period of years, mountain muhly, the bluestems, and the gramas decrease or disappear and are replaced by hairy goldenaster, three-awn, and sand dropseed. Continued heavy grazing or further depletion of the vegetation permits annual forbs, juniper, pinyon, sleepygrass, and increased amounts of three-awn to invade.

DEEP SAND RANGE SITE

This range site is made up of very rapidly permeable soils that have a surface layer of loamy sand. The slope is 2 to 7 percent. The available water capacity is low. The average annual precipitation is 12 inches, and most of the precipitation falls during thunderstorms in the period April to September. The loamy sand surface layer and the low available water capacity affects the kind and amount of vegetation produced on these soils.

The approximate potential plant community is made up of 20 percent needleandthread, 15 percent prairie sandreed, 15 percent blue grama, 10 percent sand bluestem, 15 percent side-oats grama, 15 percent sagebrush, 5 percent little bluestem, 5 percent switchgrass, 5 percent native wheatgrasses, and 5 percent sand dropseed.

If the site is in excellent condition, the total annual yield is about 2,000 pounds of air-dry herbage per acre in years of favorable moisture and 1,200 pounds per

acre in other years. Of this, about 85 percent is from plants that provide forage for cattle.

If this site is heavily grazed for a long period of years, needleandthread, switchgrass, sand bluestem, prairie sandreed, and little bluestem decrease or disappear and are replaced by blue grama, side-oats grama, and sand dropseed. Continued heavy grazing or further depletion of the vegetation permits annual forbs, yucca, cactus, and sand sagebrush to invade.

GRAVEL BREAKS RANGE SITE

This range site is made up of rapidly permeable soils that have a surface layer of gravelly sandy loam. The slope is 5 to 30 percent. The available water capacity is low. The average annual precipitation is 12 inches, and most of the precipitation falls during thunderstorms in the period April to September. The gravelly surface layer and the low available water capacity affect the kind and amount of vegetation produced on these soils.

The approximate potential plant community is made up of about 25 percent side-oats grama, 15 percent blue grama, 10 percent sand dropseed, 10 percent little bluestem, 10 percent western wheatgrass, 10 percent needleandthread, 5 percent Indian ricegrass, 5 percent fourwing saltbush, 3 percent Bigelow sagebrush, 3 percent perennial forbs, 2 percent snakeweed, and 2 percent rabbitbrush.

If the site is in excellent condition, the total annual yield is about 1,000 pounds of air-dry herbage per acre in years of favorable moisture and 500 pounds per acre in other years. Of this, about 85 percent is from plants that provide forage for cattle.

If this site is heavily grazed for a long period of years, needleandthread, side-oats grama, little bluestem, and indian ricegrass decrease or disappear and are replaced by blue grama, sand dropseed, and galleta. Continued heavy grazing or further depletion of the vegetation permits annual forbs, cactus, Bigelow sagebrush, three-awn, and perennial forbs to invade.

LIMESTONE BREAKS RANGE SITE

This range site is made up of moderately permeable soils that have a surface layer of channery loam. The slope is 1 to 65 percent. The available water capacity is very low. The average annual precipitation is 12 inches, and most of the precipitation falls during thunderstorms in the period April to September. The shallowness of the soil largely determines the kind and amount of vegetation produced on these soils.

The approximate potential plant community is made up of 25 percent side-oats grama; 20 percent New Mexico needlegrass; 12 percent blue grama; 10 percent little bluestem; 6 percent frankenia bush, cushion plants, and others; 5 percent needleandthread; 5 percent Indian ricegrass; 5 percent western wheatgrass; 3 percent galleta; 3 percent Bigelow sagebrush; 3 percent skunkbrush; and 3 percent juniper.

If the site is in excellent condition, the total annual yield is about 800 pounds of air-dry herbage per acre during years of favorable moisture and 300 pounds per acre in other years. Of this, about 85 percent is from plants that provide forage for cattle.

If this site is heavily grazed for a long period of years, the needlegrasses, little bluestem, and side-oats grama decrease or disappear and are replaced by blue grama, galleta, and three-awn. Continued heavy grazing or further depletion of the vegetation permits annual forbs, cushion plants, Bigelow sagebrush, and juniper to invade.

LOAMY FOOTHILLS RANGE SITE

This range site is made up of moderately permeable to slowly permeable soils that have a surface layer of stony loam, silt loam, or clay loam. The slope is 1 to 9 percent. The available water capacity is high. The average annual precipitation is 16 to 18 inches, and most of the precipitation falls during thunderstorms in the period April to September.

The approximate potential plant community is made up of 30 percent western wheatgrass, 20 percent needleandthread, 15 percent blue grama, 10 percent little bluestem, 10 percent prairie junegrass, 5 percent sedges and 10 percent other plants.

If the site is in excellent condition, the total annual yield is about 1,500 pounds of air-dry herbage per acre during years of favorable moisture and 900 pounds per acre in other years. Of this, about 90 percent is from plants that provide forage for cattle.

If this site is heavily grazed for a long period of years, western wheatgrass, needleandthread, and little bluestem decrease or disappear and are replaced by blue grama, sedges, and prairie junegrass. Continued heavy grazing or further depletion of the vegetation permits the invasion of annual forbs, sleepygrass, bluegrass, juniper, oak, and pinyon.

LOAMY PARK RANGE SITE

This range site is made up of slowly permeable soils that have a surface layer of silt loam. The slope is 3 to 9 percent. The available water capacity is high. The average annual precipitation is 18 inches, and most of the precipitation falls during snowstorms in winter and thunderstorms in the period May to August.

The approximate potential plant community is made up of about 30 percent mountain muhly, 25 percent Arizona fescue, 10 percent Parry oatgrass, 7 percent nodding brome, 5 percent western wheatgrass, 5 percent prairie junegrass, 3 percent little bluestem, 3 percent needlegrasses, 2 percent blue grama, and 10 percent other perennial forbs and shrubs.

If the site is in excellent condition, the total annual yield is about 1,800 pounds of air-dry herbage per acre during years of favorable moisture and 1,200 pounds per acre in other years. Of this, about 80 percent is from plants that provide forage for cattle.

If this site is heavily grazed for a long time over a period of years, Arizona fescue, mountain muhly, Parry oatgrass, and nodding brome decrease or disappear and are replaced by blue grama, western wheatgrass, and prairie junegrass. Continued heavy grazing or further depletion of the vegetation permits the invasion of annual forbs, tall rabbitbrush, horsebrush, and fringed sagewort.

LOAMY PLAINS RANGE SITE

This range site is made up of slowly permeable to moderately permeable soils that have a surface layer

of fine sandy loam, loam, silt loam, silty clay loam, or clay loam. The slope is 0 to 9 percent. The available water capacity is moderate to high. The average annual precipitation is 12 inches, and most of the precipitation falls during thunderstorms in the period April to September. The plains climate has a dominating effect on the kind and amount of vegetation produced on these soils.

The approximate potential plant community is made up of 58 percent blue grama, 10 percent western wheatgrass, 10 percent galleta, 5 percent needleandthread, 5 percent side-oats grama, 5 percent fourwing saltbush, 5 percent sand dropseed, 1 percent bottlebrush squirreltail, and 1 percent perennial forbs.

If the site is in excellent condition, the total annual yield is about 1,000 pounds of air-dry herbage per acre during years of favorable moisture and 500 pounds per acre in other years. Of this, about 85 percent is from plants that provide forage for cattle.

If this site is heavily grazed for a long period of years, western wheatgrass, side-oats grama, and needleandthread decrease or disappear and are replaced by sand dropseed, bottlebrush squirreltail, and blue grama. Continued heavy grazing or further depletion of the vegetation permits the invasion of annual forbs, three-awn, cactus, and perennial forbs.

SALINE OVERFLOW RANGE SITE

This range site is made up of moderately permeable to slowly permeable soils that have a surface layer of silt loam or silty clay loam. The slope is 0 to 2 percent. The available water capacity is high. The annual precipitation is about 12 inches, and most of the precipitation falls during thunderstorms in the period April to September. The texture of the surface layer and occasional flooding affect the kind and amount of vegetation produced on these soils.

The approximate potential plant community is made up of 35 percent alkali sacaton, 20 percent western wheatgrass, 15 percent blue grama, 10 percent vine-mesquite, and 5 percent switchgrass, 5 percent fourwing saltbush, 5 percent silverbeard, and 5 percent other plants.

If the site is in excellent condition, the total annual yield is about 1,800 pounds of air-dry herbage per acre during years of favorable moisture and 1,200 pounds per acre in other years. Of this, about 85 percent is from plants that provide forage for cattle.

If this site is heavily grazed for a long period of years, alkali sacaton and western wheatgrass decrease or disappear and are replaced by vine-mesquite and blue grama. Continued heavy grazing or further depletion of the vegetation permits the invasion of annual forbs, buffalograss, galleta, snakeweed, and perennial forbs.

SALT FLATS RANGE SITE

This range site is made up of slowly permeable and very slowly permeable soils that have a surface layer of sandy loam, silty clay loam, or silty clay. The slope is 0 to 5 percent. The available water capacity is high. The annual precipitation is about 12 inches, and most of the precipitation falls during thunderstorms in the period April to September. Slow runoff and the slow permeability of the subsoil affect the kind and amount of vegetation produced on these soils.

The approximate potential plant community is made up of 53 percent alkali sacaton, 15 percent western wheatgrass, 10 percent saltgrass, 5 percent galleta, 5 percent fourwing saltbush, 5 percent alkaligrass, and 5 percent blue grama, 1 percent buffalograss, and 1 percent rabbitbrush.

If the site is in excellent condition, the total annual yield is about 2,000 pounds of air-dry herbage per acre during years of favorable moisture and 800 pounds per acre in other years. Of this, about 85 percent is from plants that provide forage for cattle.

If this site is heavily grazed for a long period of years, western wheatgrass, alkali sacaton, and fourwing saltbush decrease or disappear and are replaced by saltgrass, blue grama, and galleta. Continued heavy grazing or further depletion of the vegetation permits the invasion of annual forbs, rabbitbrush, greasewood, and perennial forbs.

SALT MEADOW RANGE SITE

This range site is made up of slowly permeable to moderately rapidly permeable soils that have a surface layer of loamy sand, sandy loam, silt loam, or silty clay. The slope is 0 to 2 percent. The available water capacity is high. The annual precipitation is about 12 inches, and most of the precipitation falls during thunderstorms in the period April to September. The seasonal high water table affects the kind and amount of vegetation produced on these soils.

The approximate potential plant community is made up of 30 percent alkali sacaton, 20 percent switchgrass, 15 percent western wheatgrass, 10 percent saltgrass, and 5 percent alkaligrass, 5 percent sedges, 5 percent rushes, 5 percent alkali bluegrass, and 5 percent perennial forbs.

If the site is in excellent condition, the total annual yield is about 2,500 pounds of air-dry herbage per acre during years of favorable moisture and 1,800 pounds per acre in other years. Of this, about 90 percent is from plants that provide forage for cattle.

If this site is heavily grazed for a long period of years, switchgrass, alkaligrass, and alkali sacaton decrease or disappear and are replaced by blue grama, saltgrass, sedges, and rushes. Continued heavy grazing or further depletion of the vegetation permits the invasion of annual forbs, marsh muhly, and perennial forbs.

SANDSTONE BREAKS RANGE SITE

This range site is made up of shallow, moderately rapidly permeable soils that have a surface layer of sandy loam. The slope is 1 to 90 percent. The available water capacity is very low. The annual precipitation is about 12 inches and most of the precipitation falls during thunderstorms in the period April to September. The very low available water capacity and the shallowness of the soils affect the kind and amount of vegetation produced.

The approximate potential plant community is made up of about 25 percent side-oats grama, 15 percent western wheatgrass, 15 percent blue grama, 10 percent little bluestem, 10 percent big bluestem, 10 percent

prairie junegrass, 5 percent silver bluestem, 5 percent sedges, and 5 percent other plants.

If the site is in excellent condition, the total annual yield is about 900 pounds of air-dry herbage per acre during years of favorable moisture and 600 pounds per acre in other years. Of this, about 85 percent is from plants that provide forage for cattle.

If this site is heavily grazed for a long period of years, big bluestem, little bluestem, and side-oats grama decrease or disappear and are replaced by blue grama, western wheatgrass, and sand dropseed. Continued heavy grazing or further depletion of the vegetation permits the invasion of annual forbs, pinyon, juniper, three-awn, galleta, pricklypear, snakeweed, and fringed sagewort.

SANDY BOTTOMLAND RANGE SITE

This range site is made up of moderately rapidly permeable to moderately permeable soils that have a surface layer of fine sandy loam. The slope is 0 to 2 percent. The available water capacity is moderate to high. The annual precipitation is about 12 inches, and most of the precipitation falls during thunderstorms that occur from April to September. The texture of the surface layer and occasional flooding affect the kind and amount of vegetation produced on these soils.

The approximate potential plant community is made up of 20 percent switchgrass, 10 percent sand bluestem, 10 percent prairie sandreed, 10 percent blue grama, 10 percent needleandthread, 10 percent Canada wildrye, 5 percent slender wheatgrass, 5 percent side-oats grama, 5 percent tall dropseed, 5 percent sand dropseed, 5 percent sedges, and 5 percent saltgrass.

If the site is in excellent condition, the total annual yield is about 2,000 pounds of air-dry herbage per acre during years of favorable moisture and 1,800 pounds per acre in other years. Of this, about 85 percent is from plants that provide forage for grazing cattle.

If this site is heavily grazed for a long period of years, switchgrass, sand bluestem, and needleandthread decrease or disappear and are replaced by blue grama, sand dropseed, and saltgrass. Continued heavy grazing or further depletion of the vegetation permits the invasion of annual forbs, buffalograss, and perennial forbs.

SANDY FOOTHILLS RANGE SITE

This range site is made up of moderately permeable soils that have a surface layer of sandy loam. The slope is 3 to 9 percent. The available water capacity is high. The annual precipitation is about 13 inches, and most of the precipitation falls during thunderstorms in the period April to September. The sandy loam surface layer largely affects the kind and amount of vegetation produced on these soils.

The approximate potential plant community is made up of about 20 percent side-oats grama, 15 percent needleandthread, 15 percent western wheatgrass, 10 percent native bluegrasses, 10 percent little bluestem, 10 percent blue grama, 5 percent big bluestem, 5 percent prairie junegrass, 5 percent sand dropseed, and 5 percent dryland sedges.

If the site is in excellent condition, the total annual yield is about 900 pounds of air-dry herbage per acre during years of favorable moisture and 700 pounds per acre in other years. Of this, about 90 percent is from plants that provide forage for cattle.

If this site is heavily grazed for a long period of years, big bluestem, little bluestem, needleandthread, and side-oats grama decrease or disappear and are replaced by blue grama, western wheatgrass, and sand dropseed. Continued heavy grazing or further depletion of the vegetation permits the invasion of annual forbs, sleepygrass, and perennial forbs.

SANDY PLAINS RANGE SITE

This range site is made up of rapidly permeable to moderately permeable soils that have a surface layer of loamy sand, gravelly sandy loam, or sandy loam. The slope is 0 to 9 percent. The available water capacity is low to high. The annual precipitation is about 12 inches, and most of the precipitation falls during thunderstorms in the period April to May. The texture of the surface layer affects the kind and amount of vegetation produced on these soils.

The approximate potential plant community is made up of 40 percent blue grama, 10 percent side-oats grama, 10 percent prairie sandreed, 10 percent Indian ricegrass, 10 percent needleandthread, 5 percent sand dropseed, 5 percent sand bluestem, 5 percent western wheatgrass, 4 percent sand sagebrush, and 1 percent buckwheat.

If the site is in excellent condition, the total annual yield is about 1,200 pounds of air-dry herbage per acre during years of favorable moisture and 800 pounds per acre in other years. Of this, about 90 percent is from plants that provide forage for cattle.

If this site is heavily grazed for a long time, prairie sandreed, Indian ricegrass, sand bluestem, and side-oats grama decrease or disappear and are replaced by blue grama, sand dropseed, three-awn, and sand sagebrush. Continued heavy grazing or further depletion of the vegetation permits the invasion of forbs, cactus, and perennial forbs.

SHALY PLAINS RANGE SITE

This range site is made up of slowly permeable to moderately permeable soils that have a surface layer of silty clay or silty clay loam. The slope is 1 to 9 percent. The available water capacity is very low or low. The annual precipitation is about 12 inches, and most of the precipitation falls during thunderstorms in the period April to September. The very low available water capacity affects the kind and amount of vegetation produced on these soils.

The approximate potential plant community is made up of about 40 percent alkali sacaton, 20 percent blue grama, 10 percent western wheatgrass, 10 percent galleta, 5 percent winterfat, 5 percent Indian ricegrass, and 10 percent other plants.

If the site is in excellent condition, the total annual yield is about 700 pounds of air-dry herbage per acre during years of favorable moisture and 400 pounds per acre in other years. Of this, about 85 percent is from plants that provide forage for cattle.

If this site is heavily grazed for a long period of years, western wheatgrass and alkali sacaton decrease or disappear and are replaced by blue grama and

galleta. Continued heavy grazing or further depletion of the vegetation permits the invasion of annual forbs, shadscale cactus, pullup muhly, greasewood, and Fremont goldenweed.

SHALLOW FOOTHILLS RANGE SITE

This range site is made up of moderately permeable to slowly permeable soils that have a surface layer of channery loam or stony loam. The slope is 3 to 25 percent. The available water capacity is low or very low. The annual precipitation is about 16 inches, and most of the precipitation falls during thunderstorms in the period April to September. The low available water capacity affects the kind and amount of vegetation produced on these soils.

The approximate potential plant community is made up of 20 percent side-oats grama, 15 percent Scribners needlegrass, 10 percent little bluestem, 10 percent big bluestem, 10 percent needleandthread and New Mexico needlegrass, 5 percent Indian ricegrass, 5 percent mountain muhly, 5 percent Arizona fescue, 5 percent western wheatgrass, 5 percent blue grama, 5 percent juniper, 5 percent pinyon, 3 percent mountainmahogany; and 2 percent squawbush.

If the site is in excellent condition, the total annual yield is about 500 pounds of air-dry herbage per acre during years of favorable moisture and about 100 pounds per acre in other years. Of this, about 80 percent is from plants that provide forage for cattle.

If this site is heavily grazed for a long period of years, the needlegrasses, the ricegrasses, the bluestems, mountain muhly, and Arizona fescue decrease or disappear and are replaced by blue grama and sand dropseed. Continued heavy grazing or further depletion of the vegetation permits the invasion of annual forbs, cactus, yucca, pinyon, juniper, oakbrush, rose, and sleepygrass.

Woodland[3]

About 104,750 acres of forest land (*13*) of which about 18,600 is commercial forest (*3*) is in the Pueblo Area. Part of this commercial forest is on private land within the forest but not in the survey area. All of the commercial forest is ponderosa pine or mixed conifers. This forest is mainly in the Wetmore-Larkson-Pinata association, which is in the western part of the survey area, and is at an elevation of more than 5,800 feet. About 14,600 acres is a forest of ponderosa pine and 12,400 acres a forest of mixed conifers, both commercial and noncommercial.

Other forest types, all noncommercial, are pinyon-juniper and cottonwood. The pinyon-juniper, of which there is about 57,000 acres in the survey area, is in the Nunn-Stroupe-Holderness and the Penrose-Minnequa associations. The pinyon pine is used for fireplace wood and Christmas trees. About 21,250 acres is cottonwood forest in the Las Animas-Glenberg-Apishapa association along Fountain Creek and the Arkansas River. Some of it is harvested to make pallets for industry.

[3] CARY HULL, woodland conservationist, Soil Conservation Service, helped prepare this section.

The suitability of a soil for producing merchantable timber is determined by site index (*6*), which is a numerical rating giving the height of a tree at 100 years of age. Site index can be used as an indication of potential growth in a managed stand. The annual growth per acre is 25 board feet for soils that have a site index of 40, 60 board feet for a site index of 50, and 90 board feet for a site index of 60.

Forest sites are further categorized into woodland suitability groups, which place soils that have similar management requirements and growth potential in the same category (*5*).

Each woodland group is identified by a three-part symbol, such as 5r1, 5x1, or 6x1. The potential productivity of the soils in the group is indicated by the first number in the symbol: 1 means very high, 2 means high, 3 means moderately high, 4 means moderate, 5 means low, and 6 means very low. These ratings are based on field determinations of average site index. Site index of a given soil is the height, in feet, that the taller trees of a given species reach in a natural, essentially unmanaged stand in a stated number of years.

The second part of the symbol identifying a woodland suitability group is a small letter. This letter indicates an important soil property that imposes a hazard or limitation in managing the soils of the group for trees. In this survey area, only *x* and *r* are used. The letter *x* shows that the soils have restrictions or limitations for woodland use or management caused mainly by stones or rocks. The letter *r* shows that the soils have restrictions or limitations for woodland use or management caused by slope.

The last part of the symbol, another number, differentiates woodland suitability groups that have identical first and second parts in their identifying symbol. Soils in woodland group 6x1, for example, require somewhat different management than soils in group 6x2.

Table 3 gives for each woodland suitability group in the survey area the degree of limitation for various management hazards.

Equipment limitations depend on soil characteristics that restrict or prohibit the use of harvesting equipment either seasonally or continually. A *slight* limitation means that there are no restrictions in the kind of equipment or time of year it is used; *moderate* means that use of equipment is restricted for 3 months of the year or less; *severe* means that special equipment is needed and that its use is severely restricted for more than 3 months of the year.

Seedling mortality refers to mortality of naturally occurring or planted tree seedlings, as influenced by kinds of soil or topographic conditions where plant competition is not a factor. *Slight* means a loss of 0 to 25 percent; *moderate* means a loss of 26 to 50 percent; and *severe* means a loss of more than 50 percent of the seedlings. It is assumed that seed supplies are adequate.

Plant competition is the degree to which undesirable plants invade openings in the tree canopy. Available water capacity, fertility, drainage, and degree of erosion determine the degree of the limitation. *Slight* means that plant competition does not prevent adequate natural regeneration and early growth or inter-

TABLE 3.

Woodland suitability group and map symbols	Kind of cover	Site index		Erosion hazard
		Average	Range	
		Ft	*Ft*	
Group 6x1:				
VmE	Ponderosa pine	44	38–53	Moderate
PW (Wetmore part [1])	Ponderosa pine	45	40–49	Moderate
Group 6x2:				
PW (Pinata part)	Ponderosa pine	55	50–61	Moderate
Group 5r1:				
LbD	Ponderosa pine	59	56–60	Severe
LcE	Ponderosa pine	56	47–66	Severe
Group 5x1:				
WE	Mixed conifers	60	57–65	Moderate

[1] This Wetmore part is drier and has lower potential productivity than is typical of the series.

fere with seedling development. *Moderate* means that competition delays natural or artificial establishment and growth rate but does not prevent the development of fully stocked normal stands. *Severe* means that competition prevents adequate natural or artificial regeneration unless the site is prepared properly and such maintenance practices as burning, spraying, disking, or girdling are used.

Erosion hazard refers to the degree of potential soil erosion as influenced by slope class, length, and shape; soil permeability, soil structure, and protective cover. *Slight* means that problems of erosion control are unimportant; *moderate* means that some attention must be given to prevent unnecessary soil erosion; *severe* means that intensive treatments and specialized equipment and methods of operation must be planned to minimize soil erosion.

Table 3 lists preferred trees to favor in existing stands and preferred trees for planting. The estimated site index in table 3 is the height, in feet, that the tallest trees reach at 100 years of age on the soils of each group.

Only a few old, established windbreaks exist in the survey area, but some plantings have been made in recent years. Plantings for windbreaks, noise barriers, beautification, and wildlife use could be beneficial but would be limited to irrigated sites or areas where supplemental water is available for establishment.

Deep, well-drained soils that have a surface layer of loam or sandy loam are more suitable for windbreak plantings than other soils. The Vona, Olney, and Rocky Ford series are examples of suitable soils. Areas not suited to tree plantings have a surface layer of heavy clay, are poorly drained, or are strongly affected by alkaline or saline salts. Apishapa, Limon, Bloom, and Razor soils are examples of soils that are poorly suited to windbreak plantings.

Trees and shrubs best adapted for planting in the survey area are ponderosa pine, Austrian pine, eastern redcedar, Rocky Mountain juniper, Siberian elm, Russian-olive, skunkbush sumac, and lilac.

If windbreaks are established in dryland areas, the site should be engineered to make use of runoff and the rows should be widely spaced to reduce plant competition for moisture. Dryland sites should be summer fallowed prior to planting and clean cultivated thereafter.

An effective farmstead windbreak should contain at least three rows. The windward row should be a row of shrubs and the leeward, a row of evergreen trees. Survival of evergreens is markedly improved if potted planting stock is used.

If irrigation water is available, such faster growing trees as cottonwood and poplar can be used.

Wildlife[4]

Food, cover, and water are the basic elements of wildlife habitat. The available habitat largely determines the kinds of wildlife that are in the area. Although soils are the basis for habitat and habitat diversity, two factors that greatly influence wildlife populations in the Pueblo Area are soil use and water.

Application of water often changes rangeland to cropland, which in turn greatly affects the kinds of wildlife that use the land. For example, lesser prairie chickens once inhabited some of the range, but they were replaced by ring-necked pheasants when the rangeland was irrigated for crops.

A broad range of wildlife inhabit the Pueblo Area, and there is much diversity in habitat, which ranges from a semidesert to conifer-covered mountains. This diversity is largely the result of differences in elevation and accompanying climatic differences. Also, the Arkansas River and irrigation farming have provided widely different kinds of wildlife habitat.

Important wildlife species in the survey area include mule deer, pronghorn antelope, black bear, mourning dove, wild turkey, scaled quail, cottontail, and black-tailed and white-tailed jackrabbit. Some of the other wildlife in the survey area are red and kit fox, coyote, long-tailed weasel, badger, raccoon, and spotted and hognosed skunk.

The numerous birds in the survey area include golden eagle, burrowing owl, roadrunner, lark bunting, horned lark, black-billed magpie, sandhill crane, and meadow lark. A host of amphibians and reptiles, including the prairie rattlesnake, also inhabit the area.

[4] By ELDIE W. MUSTARD, JR., biologist, Soil Conservation Service.

—*Woodland*

Equipment limitations	Seedling mortality	Plant competition	Preferred trees—	
			In existing stands	For planting
Moderate	Severe	Severe	Ponderosa pine	None.
Moderate	Severe	Severe	Ponderosa pine	None.
Moderate	Moderate	Moderate	Ponderosa pine	Ponderosa pine.
Moderate	Slight	Moderate	Ponderosa pine	Ponderosa pine.
Moderate	Slight	Moderate	Ponderosa pine	Ponderosa pine.
Severe	Moderate	Moderate	Douglas-fir	Douglas-fir.

Successful management of wildlife on any tract of land requires that food, cover, and water be available in a suitable combination. Lack of any one of these necessities, unfavorable balance among them, or their poor distribution may severely limit or account for the absence of desired wildlife species. Information about soils is a valuable tool in providing alternatives for managing habitat, improving or maintaining suitable vegetation for food and cover, and locating water developments.

Soils directly influence the kinds and amount of vegetation and the amount of water available. In this way they indirectly influence the kinds of wildlife that can live in an area. Soil properties that affect the growth of wildlife habitat are thickness of soil useful to crops, surface texture, available water capacity, wetness, surface stoniness or rockiness, flood hazard, slope, and permeability of the soil to air and water.

In table 4 the soils of the Pueblo Area are rated for producing eight elements of wildlife habitat and for supporting four groups or kinds of wildlife. The ratings indicate relative suitability for various elements.

A rating of *good* means the habitats are easily improved, maintained, or created. There are few or no soil limitations in habitat management, and satisfactory results can be expected.

A rating of *fair* means the habitats can be improved, maintained, or created on these soils, but moderate soil limitations affect habitat management or development. A moderate intensity of management and fairly frequent attention may be required to ensure satisfactory results.

A rating of *poor* means the habitats can be improved, maintained, or created on these soils, but the soil limitations are severe. Habitat management may be difficult and expensive and may require intensive effort. Results are questionable.

A rating of *very poor* means that under the prevailing soil conditions, it is impractical to attempt to improve, maintain, or create habitats. Unsatisfactory results are probable.

Each soil is rated according to its suitability for producing various kinds of plants and other elements that make up wildlife habitats. The ratings take into account the main characteristics of the soils and closely related natural factors of the environment. They do not take into account climate, present use of the soils, or present distribution of wildlife and people. For this reason, selection of a site for development of habitat for wildlife requires onsite inspection.

Grain and seed crops are annual grain-producing plants, such as wheat, barley, and corn.

Grasses and legumes are domestic grasses and legumes that are established by planting and provide food and cover for wildlife. Grasses and legumes include wheatgrasses, ryegrass, alfalfa, yellow sweetclover, and other clovers.

Wild herbaceous plants are native or introduced perennial grasses and forbs that provide food and cover for upland wildlife. Canada wildrye, sunflower, indian ricegrass, and cheatgrass are typical examples. On rangeland, common plants are sand bluestem, grama grasses, wheatgrass, alkali sacaton, buffalograss, pricklypear, cholla, perennial forbs, and legumes.

Hardwood trees are nonconiferous trees, shrubs, and woody vines that produce wildlife food in the form of fruits, nuts, buds, catkins, or browse. Such plants, when climatically adapted, may be planted and developed in wildlife management programs. Typical species in this category are Gambel oak, honeysuckle, skunkbush sumac, Russian-olive, and cottonwood.

Coniferous plants are cone-bearing trees and shrubs that provide cover and frequently furnish food in the form of browse, seeds, or fruitlike cones. They may be planted and managed where they are climatically adapted. Typical plants in this category are pines, juniper, and various ornamental trees and shrubs.

Shrubs are plants that provide buds, twigs, bark, or foliage that is used as food and provides cover and shade for wildlife. These plants are used mostly in areas where they are a part of the natural vegetation. Typical plants in this category are skunkbush sumac, rabbitbrush, big sagebrush, greasewood, and sand sagebrush.

Wetland plants are annual and perennial herbaceous plants that grow wild on moist and wet sites. They furnish food and cover mostly for wetland wildlife. Typical examples of plants are smartweed, barnyardgrass, spikerush and other rushes, sedges, and cattail.

TABLE 4.—*Wildlife*

[Absence of an entry indicates that the soil was not rated. Interpretations

Soil series and map symbols	Suitability of the soils for elements of wildlife habitat				
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants
Absted: Ab	Poor	Poor	Fair		
Adena: Am	Poor	Fair	Fair		
For Manvel part, see the nonirrigated part in that series.					
Apishapa: Ap.					
Irrigated part	Fair	Good			
Nonirrigated part	Poor	Poor	Good		
Arvada: AR	Very poor	Very poor	Poor		
For Keyner part, see Keyner series.					
Baca: Bc.					
Irrigated part	Good	Good			
Nonirrigated part	Poor	Fair	Fair		
Bankard: Bk	Poor	Fair	Fair		
Bloom: Bm.					
Irrigated part	Fair	Good			
Nonirrigated part	Poor	Poor	Good		
Cascajo: CaE, CsE	Very poor	Very poor	Fair		
Denver: DeD.					
Irrigated part	Good	Good			
Nonirrigated part	Fair	Fair	Fair		
Dwyer: Dw	Poor	Fair	Fair		
Eutroboralfs: EBF					
Gilcrest: GcA, GeD, GfC	Poor	Fair	Fair		
Glenberg: Gh.					
Irrigated part	Good	Good			
Nonirrigated part	Fair	Fair	Fair		
For Haverson part, see Haverson series.					
Haverson: Ha	Fair	Fair	Fair		
Heldt: He	Poor	Fair	Fair		
Holderness: Ho	Fair	Fair	Fair		
Keyner: Ke	Poor	Poor	Fair		
Kim: Km	Poor	Poor	Fair		
LaPorte: LaE	Poor	Fair	Fair		Poor
Larkson: LbD, LcE	Poor	Fair	Good		Fair
Las Animas: Lm	Very poor	Poor	Good	Fair	
Limon: LnA, LnB, LoA, LvB.					
Irrigated part	Fair	Fair			
Nonirrigated part	Poor	Poor	Fair		
Manvel: MaA, MaB, Mg, Mn.					
Irrigated part	Good	Good			
Nonirrigated part	Poor	Poor	Fair		
Manzanola: MoD, MpA.					
Irrigated part	Good	Good			
Nonirrigated part	Poor	Fair	Fair		
Midway: MsD	Very poor	Very poor	Fair		
Minnequa: Mv	Poor	Poor	Fair		
For Manvel part, see the nonirrigated part in that series.					
Nederland: NdE	Very poor	Very poor	Fair		
Neville: NeD	Very poor	Very poor	Fair		
Nunn: NnD, NuC, NuD	Fair	Fair	Fair		
Olney: Oe, Of	Poor	Fair	Fair		
Otero:					
OoA, OoC, OrD:					
Irrigated part	Fair	Good	Good		
Nonirrigated part	Poor	Fair	Fair		
OtA, OtB:					
Irrigated part	Good	Good	Good	Good	Good
Penrose: PmE, PrF	Very poor	Very poor	Fair		
For Minnequa part, see Minnequa series.					
Pinata: PW	Very poor	Very poor	Fair		
For Wetmore part, see Wetmore series.					
Razor: Ra, Re2	Poor	Poor	Fair		
Rocky Ford: RfA, RfB, Rg.					
Irrigated part	Good	Good		Good	Good

habitat

are for nonirrigated areas unless otherwise indicated]

Suitability of the soils for elements of wildlife habitat —Continued			Suitability of the soils for kinds of wildlife			
Shrubs	Wetland plants	Shallow-water areas	Openland	Woodland	Wetland	Rangeland
Fair	Poor	Very poor	Poor		Very poor	Fair.
Fair	Poor	Very poor	Fair		Very poor	Fair.
Fair	Poor	Good	Poor		Fair	Fair.
Very poor	Poor	Very poor	Very poor		Very poor	Poor.
			Good			
Poor	Poor	Very poor	Fair		Very poor	Poor.
Fair	Poor	Very poor	Fair		Very poor	Fair.
			Good			
Fair	Very poor	Very poor	Poor		Very poor	Fair.
Fair	Very poor	Very poor	Poor		Very poor	Fair.
			Good			
Fair	Poor	Very poor	Fair		Very poor	Fair.
Fair	Very poor	Very poor	Poor		Very poor	Fair.
Fair	Very poor	Very poor	Fair		Very poor	Fair.
			Good			
Fair	Poor	Very poor	Fair		Very poor	Fair.
Fair	Poor	Very poor	Fair		Very poor	Poor.
Fair	Poor	Very poor	Fair		Very poor	Fair.
Fair	Poor	Very poor	Poor		Very poor	Fair.
Fair	Poor	Fair	Poor		Poor	Fair.
Fair	Very poor	Very poor	Fair		Very poor	Fair.
Good	Very poor	Very poor	Fair	Fair	Very poor	
Fair	Good	Good	Poor		Good	Fair.
Good			Fair			Fair.
Fair	Poor	Very poor	Poor		Very poor	Fair.
Good			Good			
Fair	Poor	Very poor	Poor		Very poor	Fair.
Good			Good			
Fair	Very poor	Very poor	Fair		Very poor	Fair.
Fair	Very poor	Very poor	Poor		Very poor	Fair.
Poor	Poor	Very poor	Poor		Very poor	Poor.
Fair	Very poor	Very poor	Poor		Very poor	Fair.
Fair	Very poor	Very poor	Poor		Very poor	Fair.
Fair	Poor	Very poor	Fair		Very poor	Fair.
Fair	Poor	Very poor	Fair		Very poor	Fair.
			Good			
Fair	Poor	Very poor	Fair		Very poor	Fair.
Good	Poor	Poor	Good		Poor	
Fair	Very poor	Very poor	Poor		Very poor	Fair.
Fair	Very poor	Very poor	Poor	Fair	Very poor	
Fair	Poor	Very poor	Poor		Very poor	Fair.
Good	Good	Poor	Good		Fair	

TABLE 4.—*Wildlife*

Soil series and map symbols	Suitability of the soils for elements of wildlife habitat				
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants
Schamber: SaE	Very poor	Very poor	Poor	Very poor	Very poor
Shingle: SgD	Very poor	Very poor	Fair		
Stoneham: Sh	Poor	Fair	Fair		
Stroupe: StE	Very poor	Very poor	Fair		
Table Mountain: TM	Good	Good	Fair		
Travessilla: ToD, TrG	Very poor	Very poor	Poor		
Valent: Va	Poor	Fair	Fair		
Vamer: VmE	Poor	Fair	Fair		
Vona: Vn, Vo, Vs2	Fair	Fair	Fair		
For Otero part, see the nonirrigated part in that series.					
Wetmore: WE					
Wetmore part	Very poor	Very poor	Poor		Poor
Mortenson part	Very poor	Very poor	Good		Good
Wiley: Wk	Poor	Fair	Fair		
For Kim part, see Kim series.					
Wormser: Wo	Poor	Fair	Fair		

Submerged and floating aquatics are not included in this category.

Shallow-water areas are areas of surface water that have an average depth of less than 5 feet and are useful to wildlife. They may be natural wet areas or areas created by dams, levees, or water-control devices in marshes or streams. Typical examples are waterfowl feeding areas, wildlife watering developments, wildlife ponds, and beaver ponds.

Table 4 rates the soils of the Pueblo Area according to their suitability as habitat for four kinds of wildlife—openland, woodland, wetland, and rangeland. These ratings are related to ratings made for the elements of the habitat. For example, soils that are *very poor* for shallow water developments are also *very poor* for wetland wildlife.

Openland wildlife are birds and mammals that inhabit croplands, pasture, meadows, lawns, and areas overgrown with grasses, herbs, shrubs, and vines. Examples are robin, western bluebird, pheasant, meadowlark, white-crowned sparrow, killdeer, cottontail rabbit, and red fox.

Woodland wildlife are birds and mammals that inhabit areas of either hardwood or coniferous trees and shrubs, or a mixture of both. Examples are wild turkey, blue grouse, pine siskin, woodpeckers, raccoon, mule deer, elk, and black bear.

Wetland wildlife are birds and mammals that inhabit swampy, marshy, or open-water areas. Examples are ducks, geese, herons, shore birds, rails, kingfishers, muskrat, mink, and beaver.

Rangland wildlife are birds and mammals that inhabit range. Examples are antelope, mule deer, coyote, kit fox, jackrabbit, roadrunner, scaled quail, horned lark, meadowlark, and lark bunting.

Engineering Uses of the Soils[5]

This section is useful to planning commissions, town and city managers, land developers, engineers, contractors, farmers, and others who need information about soils used as structural material or as foundation on which structures are built.

Among the properties of soils that are highly important in engineering are permeability, strength, compaction characteristics, drainage, shrink-swell potential, grain size, plasticity, and reaction. Also important are depth to the water table, depth to bedrock, and slope. These properties, in various degrees and combinations, affect the construction and maintenance of roads, airports, pipelines, foundations for small buildings, irrigation systems, ponds and small dams, and systems for disposal of sewage and refuse.

Information in this section of the soil survey can be helpful to those who—

1. Select potential residential, industrial, commercial, and recreational areas.
2. Evaluate alternate routes for roads, highways, pipelines, and underground cables.
3. Seek sources of gravel, sand, or clay.
4. Plan farm drainage systems, irrigation systems, ponds, terraces, and other structures for controlling water and conserving soil.
5. Correlate performance of structures already built with properties of the soils on which they are built to help predict performance of structures on the same or similar kinds of soil in other locations.

[5] ROBERT L. CLARKE, engineer, Soil Conservation Service, helped prepare this section.

habitat—Continued

Suitability of the soils for elements of wildlife habitat—Continued			Suitability of the soils for kinds of wildlife			
Shrubs	Wetland plants	Shallow-water areas	Openland	Woodland	Wetland	Rangeland
Very poor	Very poor	Very poor	Very poor		Very poor	Poor.
Fair	Very poor	Very poor	Poor		Very poor	Fair.
Fair	Poor	Very poor	Fair		Very poor	Fair.
Fair	Very poor	Very poor	Poor		Very poor	Fair.
Fair	Poor	Very poor	Good		Very poor	Fair.
			Very poor			Poor.
Fair	Very poor	Very poor	Poor		Very poor	Fair.
Fair	Very poor	Very poor	Poor		Very poor	Fair.
Fair	Poor	Very poor	Fair		Very poor	Fair.
Good	Very poor	Very poor	Very poor	Poor	Very poor	
Good	Very poor	Very poor	Poor	Poor	Very poor	
Poor	Poor	Very poor	Fair		Very poor	Poor.
Fair	Poor	Poor	Fair		Poor	Fair.

6. Predict the trafficability of soils for cross-country movement of vehicles and construction equipment.
7. Develop preliminary estimates pertinent to construction in a particular area.

Most of the information in this section is presented in tables. Table 5 shows estimated soil properties significant in engineering. Table 6 gives interpretations for various engineering uses. Table 7 shows the interpretations of soils for land use planning.

This information, however, does not eliminate the need for further investigation at sites selected for engineering works, especially works that involve heavy loads or that require excavations to depths greater than those shown in tables, generally depths of more than 6 feet. Also, inspection of sites, especially the small ones, is needed because many delineated areas of a given soil can include small areas of other kinds of soil that have strongly contrasting properties and different suitability or limitations for soil engineering.

Some of the terms used in this soil survey have special meaning to soil scientists. The Glossary defines many of these terms as they are commonly used in soil science.

Classification systems

The two systems most commonly used in classifying samples of soils for engineering are the Unified system, used by the Soil Conservation Service, the Department of Defense, and other agencies, and the system adopted by the American Association of State Highway and Transportation Officials (AASHTO).

In the Unified system, soils are classified according to particle-size distribution, plasticity, liquid limit, and organic matter (*2*). Soils are grouped in 15 classes. There are eight classes of coarse-grained soils, identified as GW, GP, GM, GC, SW, SP, SM, and SC; six classes of fine-grained soils, identified as ML, CL, OL, MH, CH, and OH; and one class of highly organic soils, identified as Pt. Soils on the borderline between two classes are designated by symbols for both classes, for example, CL-ML.

The AASHTO system is used to classify soils according to properties that affect their use in highway construction and maintenance (*1*). In this system, a soil is placed in one of seven basic groups that range from A–1 to A–7 on the basis of grain-size distribution, liquid limit, and plasticity index. In group A–1 are gravelly soils of high bearing strength, or the best soils for subgrade (foundation). At the other extreme, in group A–7, are clay soils that have low strength when wet and that are the poorest soils for subgrade. Where laboratory data are available to justify a further breakdown, the A–1, A–2, and A–7 groups are divided as follows: A–1–a, A–1–b; A–2–4, A–2–5, A–2–6, A–2–7; and A–7–5 and A–7–6. As additional refinement, the engineering value of a soil material can be indicated by a group index number. Group indexes range from 0 for the best material to 20 or more for the poorest.

Soil properties

Several estimated soil properties significant in engineering are shown in table 5. These estimates are made for typical soil profiles, by layers sufficiently different to have different significance for soil engineering. The estimates are based on field observations made in the course of mapping, on test data for these and similar soils, and on experience with the same kinds of soil in other counties. Following are explanations of some of the column headings in table 5.

TABLE 5.—*Estimated engineering*

[The symbol > means more than;

Soil series and map symbols	Depth to seasonal high water table	Depth from surface	USDA texture	Classification		Coarse fraction greater than 3 inches
				Unified	AASHTO	
	Feet	*Inches*				*Percent*
Absted: Ab	>6	0–2	Silt loam, clay loam, fine sandy loam.	ML, CL, SM	A–4, A–6	0
		2–13	Silty clay loam, clay loam	CL	A–6, A–7	0
		13–60	Silty clay loam, clay loam, silty clay.	CL	A–6, A–7	0
Adena: Am	>6	0–3	Loam, silt loam, fine sandy loam.	ML, SM	A–4	0
For Manvel part, see Manvel series.		3–12	Clay loam, silty clay loam	CH, CL	A–6, A–7	0
		12–60	Silt loam	ML	A–4	0
Apishapa: Ap	2–3	0–8	Silty clay loam, silty clay	CL	A–6	0
		8–60	Clay, silty clay	CL, CH	A–7	0
Arvada: AR	>6	0–3	Sandy loam, loamy sand	SM, SM–SC	A–2, A–4	0
For Keyner part, see Keyner series.		3–12	Clay loam, clay	CL, CH	A–7	0
		12–60	Clay loam	CL	A–7, A–6	0
Baca: Bc	>6	0–5	Loam, silty clay loam	ML, CL, CL–ML	A–4, A–6	0
		5–21	Silty clay loam, clay loam	CL	A–7, A–6	0
		21–60	Loam, silt loam	ML, CL, CL–ML	A–4, A–6	0
Bankard: Bk	>6	0–60	Stratified sand, loamy sand, sandy loam.	SP–SM, SM	A–2, A–3	0
Bloom: Bm	1½–3	0–8	Silt loam	CL, CL–ML	A–4, A–6	0
		8–60	Silty clay loam	CL	A–6, A–4	0
Cascajo: CaE, CsE	>6	0–10	Very gravelly sandy loam, very gravelly sand.	GP–GM, GM	A–1	0–20
Shale outcrop part of CsE is too variable to estimate.		10–21	Very gravelly sandy loam, very gravelly sand, very gravelly loamy sand.	GP–GM	A–1	25–35
		21–60	Stratified very gravelly loamy sand, very gravelly sand.	GP, GM	A–1	20–30
Denver: DeD	>6	0–12	Silty clay loam, clay loam	CL	A–6, A–7	0
		12–22	Silty clay, clay loam, clay	CH, CL	A–7	0
		22–50	Silty clay, clay loam, clay	CL, CH	A–6, A–7	0
		50–60	Shale.			
Dwyer: Dw	>6	0–60	Loamy sand	SM, SP–SM	A-2, A–3	0
Eutroboralfs: EBF. Too variable to estimate.						
Gilcrest: GcA, GeD, GfC	>6	0–4	Sandy loam, gravelly sandy loam.	SM	A–2, A–1	0
		4–35	Gravelly sandy loam	SM	A–2, A–1	0
		35–60	Gravelly sand, gravelly loamy sand.	SP–SM, SM, GP–GM, GM	A–1	0
Glenberg: Gh	>6	0–5	Fine sandy loam	SM, SC–SM	A–4	0
For Haverson part, see Haverson series.		5–60	Stratified loamy fine sand, fine sandy loam, loam.	SM, SC–SM	A–2, A–4	0
Haverson: Ha	>6	0–6	Loam, silty clay loam, silt loam	ML, CL–ML, CL	A–4, A–6	0
		6–60	Stratified silty clay loam, silt loam, loam, fine sandy loam.	ML	A–4	0
Haverson part of Gh	>6	0–6	Fine sandy loam	SM, SC–SM	A–2, A–4	0
		6–60	Stratified silty clay loam, silt loam, loam, fine sandy loam.	ML	A–4	0

properties of the soils

the symbol < means less than]

Percentage less than 3 inches passing sieve—				Permeability	Available water capacity	Reaction	Salinity	Shrink-swell potential	Hydrologic soil group
No. 4 (4.7 mm)	No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)						
				In per hr	*In per in of soil*	*pH*	*Mmhos/cm at 25°C*		
100	90–100	70–100	40–90	0.2–6.0	0.13–0.21	7.9–8.4	0–4	Moderate	C
100	95–100	95–100	85–95	0.06–0.2	0.19–0.21	7.9–9.0	2–4	Moderate.	
100	95–100	95–100	80–95	0.06–0.2	0.16–0.18	8.4–9.0	4–8	Moderate.	
100	100	70–100	40–90	0.6–6.0	0.18–0.21	7.4–7.8	<2	Low	C
100	100	95–100	80–90	0.06–0.2	0.17–0.19	7.4–7.8	<2	High.	
100	100	90–100	55–90	0.6–2.0	0.16–0.19	7.4–8.4	<2	Low.	
100	95–100	90–100	70–85	0.2–0.6	0.14–0.18	7.9–8.4	2–15	High	C
100	95–100	90–100	75–95	0.06–0.2	0.10–0.18	7.9–9.0	2–15	High.	
100	95–100	50–65	20–40	2.0–20	0.06–0.12	7.9–8.4	<2	Low	D
100	95–100	85–100	80–95	0.06–0.2	0.14–0.16	8.5–9.0	<2	High.	
100	90–100	80–90	65–80	<0.06	0.14–0.21	8.5–9.0	2–8	High.	
100	100	85–95	70–90	0.6–2.0	0.16–0.20	7.4–8.4	0–2	Moderate	C
100	100	90–100	75–95	0.2–0.6	0.16–0.20	7.9–8.4	0–2	High.	
100	100	85–95	70–90	0.6–2.0	0.16–0.20	7.9–8.4	0–2	Moderate.	
95–100	80–100	50–70	5–35	6.0–20	0.05–0.10	7.4–8.4	0–4	Low	A
95–100	95–100	85–100	70–90	0.6–2.0	0.17–0.20	7.9–8.4	0–16	Moderate	D
95–100	95–100	95–100	85–95	0.6–2.0	0.18–0.60		2–4	Moderate.	
25–35	30–40	15–30	5–15	2.0–6.0	0.07–0.09	7.4–8.4	<2	Low	A
10–20	10–20	5–10	5–10	6.0–20	0.07–0.09	7.4–8.4	<2	Low.	
10–20	10–20	5–10	0–5	6.0–20	0.03–0.06	7–4–8.4	<2	Low.	
95–100	90–100	75–100	80–90	0.2–0.6	0.16–0.20	7.4–7.8	<2	High	C
95–100	95–100	90–100	85–100	0.06–0.2	0.14–0.18	7.4–8.4	<2	High.	
95–100	90–100	80–100	75–95	0.06–0.2	0.14–0.18	7.4–8.4	<2	High.	
100	95–100	75–90	5–20	>20	0.07–0.12	7.4–8.4	<2	Low	A
80–90	75–85	30–50	20–30	6.0–20	0.07–0.10	6.6–7.8	<2	Low	B
80–90	65–75	30–50	15–35	6.0–20	0.07–0.09	6.6–7.8	<2	Low.	
75–85	65–75	15–30	5–15	6.0–20	0.04–0.06	7.9–8.4	<2	Low.	
95–100	85–100	60–80	35–45	2.0–6.0	0.09–0.13	7.9–8.4	<2	Low	B
90–100	75–100	50–70	25–40	6.0–20	0.07–0.12	7.9–8.4	<2	Low.	
95–100	80–100	75–95	50–90	0.6–2.0	0.14–0.18	7.9–8.4	0–8	Low	B
95–100	75–100	65–95	50–85	0.6–2.0	0.14–0.18	7.4–8.4	0–8	Low.	
95–100	80–100	60–70	30–50	2.0–6.0	0.12–0.15	7.9–8.4	0–8	Low	B
95–100	75–100	65–95	50–85	0.6–2.0	0.14–0.18	7.4–8.4	0–8	Low.	

TABLE 5.—*Estimated engineering*

Soil series and map symbols	Depth to seasonal high water table	Depth from surface	USDA texture	Classification		Coarse fraction greater than 3 inches
				Unified	AASHTO	
	Feet	*Inches*				*Percent*
Heldt: He	>6	0–3	Silty clay loam, silty clay, clay	CH, CL	A–7	0
		3–60	Clay, silty clay, clay loam	CH, CL	A–7	0
Holderness: Ho	>6	0–6	Loam, silt loam	ML, CL–ML	A–4, A–6	0
		6–30	Clay loam, silty clay loam	CL	A–6, A–7	0
		30–48	Loam, clay loam	CL, CL–ML	A–6, A–4	0
		48–60	Sandstone.			
Keyner:						
Ke	2–4	0–5	Loamy sand	SM	A–2	0
		5–36	Sandy clay loam	SC	A–6	0
		36–60	Stratified sandy loam, gravelly sand.	SM	A–2	0
Keyner part of AR	>6	0–5	Loamy fine sand	SM	A–2	0
		5–24	Sandy clay loam, clay loam	SC	A–6	0
		24–60	Sandy loam	SM, SM–SC	A–4	0
Kim: Km	>6	0–5	Loam, fine sandy loam	ML, SM	A–4	0
		5–60	Loam, silt loam	ML, CL, CL–ML	A–4, A–6	0
LaPorte: LaE	>6	0–17	Channery loam, loam	SM, SC–SM, ML, CL–ML	A–4	0–10
		17	Weathered bedrock.			
Larkson:						
LbD	>6	0–10	Loam	CL–ML, CL	A–4, A–6	0
		10–60	Clay loam, clay	CL, CH	A–7	0
LcE	>6	0–5	Stony loam	CL–ML, CL	A–4	0–60
		5–41	Clay loam	CL	A–6, A–7	0
		41–60	Loam, gravelly sandy loam	CL, SC	A–4, A–6	0–20
Las Animas: Lm	1½–3	0–60	Stratified fine sandy loam, loamy fine sand, silty clay loam.	SM, SC–SM	A–4	0
Limon: LnA, LnB, LoA, LvB	>6	0–60	Silty clay loam, silty clay, clay	CL, CH	A–6, A–7	0
Manvel:						
MaA, MaB, Mg	>6	0–4	Loam, silty clay loam	CL–ML, CL	A–4, A–6	0
		4–60	Silt loam, silty clay loam	CL	A–6	0
Mn	3½–5	0–4	Loam, silty clay loam	CL–ML, CL	A–4, A–6	0
		4–60	Silt loam, silty clay loam	CL	A–6	0
Manzanola: MoD, MpA	>6	0–4	Clay loam, silty clay loam	CL	A–6	0
		4–34	Clay, silty clay loam	CL, CH	A–6, A–7	0
		34–60	Clay loam	CL	A–6	0
Midway: MsD Shale outcrop part is too variable to estimate.	>6	0–9	Silty clay	CL, CH	A–6, A–7	0
		9–12	Weathered bedrock.			
Minnequa: Mv For Manvel part, see Manvel series.	>6	0–32	Silty clay loam, loam, silt loam	ML, CL–ML	A–4, A–6	0
		32	Weathered bedrock.			
Mortenson Mapped only with Wetmore soils.	>5	0–30	Very stony fine sandy loam	ML, SM	A–4	20–30
		30–60	Very stony clay loam	GC	A–2	25–40
Nederland: NdE	>6	0–8	Stony sandy loam	SM, SC–SM	A–2	10–20
		8–26	Gravelly sandy clay loam, gravelly sandy loam.	GC–GM, GC	A–2	10–20
		26–60	Very gravelly loamy sand, very gravelly sand.	GW–GM	A–1	15–25

properties of the soils—Continued

Percentage less than 3 inches passing sieve—				Permeability	Available water capacity	Reaction	Salinity	Shrink-swell potential	Hydrologic soil group
No. 4 (4.7 mm)	No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)						
				In per hr	*In per in of soil*	*pH*	*Mmhos/cm at 25°C*		
100	95–100	95–100	85–100	0.2–0.6	0.17	7.9–8.4	0–8	High	C
100	95–100	95–100	85–100	0.06–0.2	0.15–0.17	7.9–8.4	0–8	High.	
90–100	90–100	75–95	55–80	0.6–2.0	0.17–0.21	6.6–7.3	<2	Low	C
90–100	90–100	85–95	60–85	0.06–0.2	0.15–0.19	6.6–7.3	<2	High.	
90–100	80–100	60–90	50–75	0.2–0.6	0.15–0.19	7.4–8.4	<2	Moderate.	
90–100	90–100	50–75	15–35	2.0–6.0	0.06–0.08	7.9–8.4	2–8	Low	D
90–100	90–100	60–90	35–50	0.06–0.2	0.10–0.12	7.9–8.4	2–8	Moderate.	
90–100	65–85	40–60	20–35	2.0–6.0	0.06–0.08	8.5–9.0	2–8	Low.	
90–100	90–100	50–75	15–35	2.0–6.0	0.06–0.08	7.9–8.4	<2	Low	D
90–100	90–100	60–90	35–50	0.06–0.6	0.10–0.12	7.9–8.4	<2–8	Moderate.	
90–100	75–100	50–85	35–50	2.0–6.0	0.06–0.08	8.5–9.0	<2–8	Low.	
80–100	75–100	60–90	45–75	0.6–2.0	0.16–0.18	7.9–8.4	<2	Low	B
80–100	75–100	70–95	60–85	0.6–2.0	0.16–0.20	7.9–8.4	<2	Low.	
75–100	65–100	65–80	40–70	0.6–2.0	0.13–0.18	7.4–8.4	0–2	Low	C
95–100	80–100	75–95	50–75	0.6–2.0	0.16–0.18	6.1–7.3	<2	Low	C
95–100	80–100	75–95	60–90	0.06–0.2	0.15–0.21	6.6–7.8	<2	High.	
90–100	75–100	70–95	55–75	0.6–2.0	0.16–0.18	6.6–7.3	<2	Low	C
85–100	85–100	75–90	65–75	0.2–0.6	0.19–0.21	6.6–7.3	<2	Moderate.	
80–100	75–100	60–80	40–65	0.6–2.0	0.14–0.18	6.6–7.3	<2	Low.	
95–100	90–100	50–75	35–50	2.0–6.0	0.13–0.15	7.9–8.4	2–16	Low	C
100	95–100	95–100	75–95	0.06–0.2	0.14–0.17	7.9–9.0	2–8	High	C
95–100	95–100	95–100	70–90	0.6–2.0	0.18–0.20	7.9–8.4	0–2	Low	C
95–100	95–100	95–100	80–90	0.2–0.6	0.16–0.18	7.9–8.4	2–4	Low.	
95–100	95–100	95–100	70–90	0.6–2.0	0.18–0.20	7.9–8.4	0–2	Low	C
95–100	95–100	95–100	80–90	0.2–0.6	0.16–0.18	7.9–8.4	2–8	Low.	
95–100	80–95	70–95	60–75	0.2–2.0	0.15–0.20	7.4–8.4	>2	Moderate	C
95–100	90–100	85–95	70–95	0.06–0.2	0.15–0.18	7.4–8.4	>2	High.	
95–100	90–100	85–95	60–80	0.2–0.6	0.16–0.20	7.4–8.4	>2	Moderate.	
100	100	90–100	75–95	0.06–0.2	0.12–0.17	7.9–9.0	2–8	High	D
90–100	95–100	80–100	65–90	0.2–2.0	0.18–0.20	7.9–8.4	<2	Low	B
90–95	80–90	60–70	45–55	0.6–6.0	0.14–0.18	5.6–6.0	<2	Low	C
50–60	35–45	30–40	25–35	0.06–0.2	0.09–0.12	5.6–7.3	<2	Low.	
80–90	70–85	40–55	20–35	2.0–6.0	0.07–0.10	6.1–7.3	<2	Low	B
50–60	40–50	30–40	20–30	0.6–2.0	0.08–0.12	6.1–7.3	<2	Low.	
40–50	35–45	25–35	5–15	2.0–20	0.06–0.09	6.1–7.8	<2	Low.	

TABLE 5.—*Estimated engineering*

Soil series and map symbols	Depth to seasonal high water table	Depth from surface	USDA texture	Classification		Coarse fraction greater than 3 inches
				Unified	AASHTO	
	Feet	*Inches*				*Percent*
Neville: NeD	>6	0–4	Sandy loam	SC–SM	A–2	0
		4–60	Loam, sandy clay loam	CL, CL–ML	A–6	0
Nunn: NnD, NuC, NuD	>6	0–9	Clay loam, loam, stony loam	CL	A–6, A–4	0–10
		9–32	Clay loam	CL	A–6, A–7	0
		32–60	Loam	CL–ML, CL	A–4	0
Olney:						
Oe	>6	0–8	Loamy sand	SM	A–2	0
		8–16	Sandy clay loam	SC, CL	A–6	0
		16–22	Sandy loam, sandy clay loam, fine sandy loam.	SC, SM, ML	A–4, A–6	0
		22–60	Fine sandy loam, loamy fine sand, loam.	SM	A–2	0
Of	>6	0–8	Sandy loam, fine sandy loam	SM, SM–SC	A–2, A–4	0
		8–16	Sandy clay loam	SC, CL	A–6	0
		16–22	Sandy loam, sandy clay loam, fine sandy loam.	SC, SM, ML	A–4, A–6	0
		22–60	Fine sandy loam, loamy fine sand, loam.	SM	A–2	0
Otero:						
OoA, OoC, OrD	>6	0–4	Sandy loam, fine sandy loam, loamy fine sand, gravelly sandy loam.	SM	A–2	0–10
		4–60	Sandy loam, gravelly sandy loam.	SM	A–2	0–10
OtA, OtB	>6	0–12	Clay loam	CL	A–6	0
		12–60	Stratified loam, loamy sand	SM, SC–SM	A–2, A–4	0
Penrose: PmE, PrF For Minnequa part of PmE, see Minnequa series; Rock outcrop part of PrF is too variable to estimate.	>6	0–12	Channery loam	ML, CL–ML	A–4	0–10
		12	Weathered bedrock.			
Pinata: PW For Wetmore part, see Wetmore series.	>5	0–8	Very stony loam	SM, ML	A–4	15–30
		8–60	Very stony clay loam, stony clay, stony sandy clay.	GC	A–6, A–7	30–50
Razor: Ra, Re2	>6	0–4	Clay, clay loam	CL, CH	A–7, A–6	0
		4–30	Silty clay, clay	CL, CH	A–7	0
		30–52	Weathered bedrock.			
Rocky Ford:						
RfA, RfB	>6	0–12	Clay loam, silty clay loam	CL	A–6, A–7	0
		12–60	Silt loam, silty clay loam	CL–ML, CL	A–4	0
Rg	2½–4.0	0–11	Silty clay loam, clay loam	CL	A–6	0
		11–30	Silty clay loam, silt loam	CL–ML, CL	A–4	0
		30–60	Stratified silt loam, loamy very fine sand.	ML, CL–ML	A–4	0
Schamber: SaE	>5	0–9	Gravelly sandy loam, loamy sand.	SM	A–2, A–1	0–15
		9–60	Very gravelly loamy sand	SM–SW, SM, GM–GW, GW	A–2, A–1	0–25
Shingle: SgD		0–13	Silty clay loam, clay loam	CL	A–6	0
		13–20	Weathered shale.			
Stoneham: Sh	>6	0–4	Loam	ML, CL–ML	A–4	0
		4–14	Clay loam, sandy clay loam	CL, SC	A–6	0
		14–60	Loam, sandy loam	ML, CL–ML, CL	A–4	0

properties of the soils—Continued

Percentage less than 3 inches passing sieve—				Permeability	Available water capacity	Reaction	Salinity	Shrink-swell potential	Hydrologic soil group
No. 4 (4.7 mm)	No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)						
				In per hr	*In per in of soil*	*pH*	*Mmhos/cm at 25°C*		
90–100	75–90	50–65	25–35	0.6–6.0	0.13–0.18	6.6–7.3	<2	Low	B
90–100	85–95	70–85	50–60	0.6–2.0	0.16–0.21	7.9–8.4	<2	Low.	
95–100	80–95	70–95	60–75	0.6–2.0	0.15–0.20	6.6–7.8	<2	Moderate	C
95–100	90–100	85–95	65–75	0.06–0.2	0.15–0.18	7.4–8.4	<2	High.	
80–100	80–100	60–90	50–75	0.6–2.0	0.10–0.18	7.4–8.4	<2	Moderate.	
95–100	90–100	60–90	5–25	6.0–20	0.06–0.13	6.6–7.8	<2	Low	B
95–100	90–100	80–100	40–55	0.6–2.0	0.13–0.15	6.6–7.8	<2	Moderate.	
95–100	95–100	75–95	35–65	0.6–2.0	0.11–0.15	7.9–8.4	<2	Low.	
95–100	95–100	70–95	20–35	2.0–6.0	0.06–0.13	7.9–8.4	<2	Low.	
95–100	90–100	70–95	30–45	0.6–6.0	0.11–0.15	6.6–7.8	<2	Low	B
95–100	90–100	80–100	40–55	0.6–2.0	0.13–0.15	6.6–7.8	<2	Moderate.	
95–100	95–100	75–95	35–65	0.6–2.0	0.11–0.15	7.9–8.4	<2	Low.	
95–100	95–100	70–95	20–35	2.0–6.0	0.06–0.13	7.9–8.4	<2	Low.	
95–100	85–100	50–80	15–35	6.0–20	0.08–0.13	7.4–8.4	<2	Low	B
95–100	80–100	50–80	20–35	6.0–20	0.10–0.12	7.4–8.4	<4	Low.	
95–100	95–100	85–95	70–80	0.2–0.6	0.19–0.21	7.4–8.4	<2	Moderate	B
95–100	90–100	60–70	30–40	6.0–20	0.13–0.16	7.4–8.4	<2	Low.	
90–100	75–95	60–90	50–70	0.6–2.0	0.15–0.18	7.9–8.4	<2	Low	D
80–95	75–90	5–90	45–65	0.6–2.0	0.10–0.12	6.1–7.3	<2	Low	C
50–60	40–50	35–45	35–45	0.06–0.2	0.07–0.09	6.1–7.8	<2	High.	
95–100	95–100	95–100	70–90	0.06–0.2	0.14–0.17	7.4–8.4	<2	High	C
95–100	95–100	95–100	75–95	0.06–0.2	0.12–0.16	7.9–9.0	2–8	High.	
100	100	80–100	75–95	0.6–2.0	0.19–0.21	7.9–8.4	<2	Moderate	B
100	95–100	75–100	75–95	0.6–2.0	0.19–0.21	7.9–8.4	<2	Low.	
100	100	80–100	75–95	0.2–0.6	0.19–0.21	7.9–8.4	2–4	Moderate	B
100	95–100	75–100	75–95	0.6–2.0	0.19–0.21	7.9–8.4	2–4	Moderate.	
100	90–100	70–90	65–80	0.6–2.0	0.10–0.21	7.9–8.4	2–4	Low.	
80–100	70–85	45–60	20–35	6.0–20	0.06–0.10	6.8–8.4	<2	Low	A
45–60	35–45	15–30	5–15	6.0–20	0.06–0.10	7.9–8.4	<2	Low.	
90–100	90–100	85–100	75–95	0.6–2.0	0.16–0.21	7.9–8.4	2–8	Moderate	D
90–100	75–85	65–80	50–65	0.6–2.0	0.16–0.18	6.6–7.8	<2	Low	B
95–100	90–100	80–90	45–65	0.6–2.0	0.14–0.21	7.4–7.8	<2	Moderate.	
95–100	75–100	60–95	50–75	0.6–2.0	0.11–0.18	7.9–8.4	<2	Low.	

TABLE 5.—*Estimated engineering*

Soil series and map symbols	Depth to seasonal high water table	Depth from surface	USDA texture	Classification		Coarse fraction greater than 3 inches
				Unified	AASHTO	
	Feet	*Inches*				*Percent*
Stroupe: StE	>6	0–9	Stony loam, very stony loam	SM, ML	A–4	45–70
		9–25	Stony clay, very stony clay, very stony clay loam.	GC	A–6, A–7, A–2	30–50
		25	Unweathered bedrock.			
Table Mountain: TM	>6	0–7	Loam, fine sandy loam, clay loam.	CL–ML, CL, SC–SM, SC	A–4	0
		7–60	Loam, silt loam, silty clay loam	CL–ML, CL	A–4	0
Travessilla: ToD, TrG	>6	0–14	Sandy loam, gravelly sandy loam.	SM, SC–SM	A–2	0–25
Rock outcrop part of TrG is too variable to estimate.		14	Unweathered bedrock.			
Valent: Va	>6	0–4	Fine sand, loamy sand	SM, SC–SM	A–2	0
		4–60	Fine sand, sand	SP–SM, SM	A–2, A–3	0
Vamer: VmE	>6	0–12	Very stony loam, very stony clay loam.	GC	A–6	30–60
Rock outcrop part is too variable to estimate.		12	Unweathered bedrock.			
Vona:						
Vo	>6	0–8	Sandy loam	SM, SC–SM	A–2, A–4	0
		8–30	Fine sandy loam, sandy loam	SM, SC–SM	A–2, A–4	0
		30–60	Sandy loam, loamy fine sand	SM	A–2	0
Vn, Vs2	>6	0–8	Loamy fine sand, loamy sand	SM	A–2	0
For Otero part of Vs2, see Otero series.		8–30	Fine sandy loam, sandy loam	SM, SC–SM	A–2, A–4	0
		30–60	Sandy loam, loamy fine sand	SM	A–2	0
Wetmore: WE	>6	0–12	Gravelly coarse sandy loam	SC–SM, SC	A–2	5–20
For Mortenson part, see Mortenson series.		12–18	Gravelly coarse sandy loam, sandy clay loam.	SC, GC	A–2	5–40
		18	Unweathered bedrock.			
Wiley: Wk	>6	0–6	Silt loam, loam	CL–ML, CL	A–4, A–6	0
For Kim part, see Kim series.		6–15	Silty clay loam, silt loam	CL	A–6	0
		15–50	Silt loam, silty clay loam, loam	CL–ML, CL	A–4, A–6	0
		50–60	Weathered shale and sandstone.			
Wormser: Wo	>6	0–4	Silt loam	ML, CL–ML	A–4	0
		4–33	Clay loam, clay, silty clay loam	CL	A–6, A–7	0
		33	Unweathered bedrock.			

Depth to bedrock is the distance from the surface of the soil to the rock layer (fig. 7).

Depth to seasonal high water table is the distance from the surface of the soil to the highest level that ground water reaches in the soil in most years.

Soil texture is described in table 5 in the standard terms used by the Department of Agriculture. These terms take into account the relative percentages of sand, silt, and clay in soil material that is less than 2 millimeters in diameter. "Loam," for example, is soil material that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the soil contains gravel or other particles coarser than sand, an appropriate modifier is added, for example, "gravelly loamy sand." "Sand," "silt," "clay," and some of the other terms used are defined in the Glossary of this soil survey.

Permeability is that quality of a soil that enables it to transmit water or air. It is estimated on the basis of those soil characteristics observed in the field, particularly structure and texture. The estimates in table 5 do not take into account lateral seepage or such transient soil features as plowpans and surface crusts.

Available water capacity is the ability of soils to hold water for use by most plants. It is commonly defined as the difference between the amount of water in the soil at field capacity and the amount at the wilting point of most crop plants.

Reaction is the degree of acidity or alkalinity of a soil, expressed as a pH value. The pH value and terms used to describe soil reaction are explained in the Glossary.

Salinity refers to the amount of soluble salts in the soil. It is expressed as the electrical conductivity of the

properties of the soils—Continued

Percentage less than 3 inches passing sieve—				Permeability	Available water capacity	Reaction	Salinity	Shrink-swell potential	Hydrologic soil group
No. 4 (4.7 mm)	No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)						
				In per hr	*In per in of soil*	*pH*	*Mmhos/cm at 25°C*		
80–95	75–90	65–85	45–65	0.6–2.0	0.05–0.07	6.6–7.8	<2	Low	C
50–60	35–45	30–40	25–40	0.06–0.2	0.07–0.09	7.4–8.4	<2	Moderate.	
100	90–100	65–95	35–75	0.6–2.0	0.16–0.19	6.1–7.4	<2	Low	B
100	90–100	75–100	60–90	0.6–2.0	0.16–0.21	6.6–8.4	<2	Low.	
85–100	75–90	40–65	25–35	0.6–2.0	0.08–0.13	7.2–8.0	<2	Low	D
100	100	65–85	15–35	>20	0.07–0.12	6.6–7.3	<2	Low	A
100	95–100	65–80	5–20	>20	0.05–0.10	6.6–7.8	<2	Low.	
55–65	45–55	40–50	35–45	0.06–0.2	0.11–0.18	6.6–7.3	<2	High	D
100	90–100	60–85	30–45	2.0–6.0	0.11–0.13	6.6–7.3	<2	Low	B
100	90–100	65–90	30–50	6.0–20	0.12–0.14	6.6–8.4	<2	Low.	
100	90–100	50–70	15–30	>20	0.08–0.11	7.4–8.4	<2	Low.	
100	90–100	50–75	15–30	>20	0.09–0.11	6.6–7.3	<2	Low	B
100	90–100	65–90	30–50	6.0–20	0.12–0.14	6.6–8.4	<2	Low.	
100	90–100	50–70	15–30	20	0.08–0.11	7.4–8.4	<2	Low.	
60–80	60–75	35–45	20–30	6.0–20	0.07–0.09	6.1–7.3	<2	Low	D
60–70	55–65	30–40	25–35	6.0–20	0.07–0.09	6.1–7.3	<2	Low.	
100	100	90–100	70–90	0.6–2.0	0.19–0.21	7.4–7.8	<2	Low	B
100	100	90–100	70–95	0.2–0.6	0.19–0.21	7.9–8.4	<2	Low.	
100	100	90–100	70–90	0.2–0.6	0.16–0.21	7.9–8.4	<2	Low.	
95–100	95–100	90–100	70–90	0.2–0.6	0.19–0.21	6.6–7.3	2–8	Low	D
95–100	95–100	90–100	70–95	0.06–0.2	0.19–0.21	6.6–8.4	2–8	High.	

saturation extract, in millimhos per centimeter at 25° C. Salinity affects the suitability of a soil for crops, its stability when used as construction material, and its corrosiveness to metals and concrete.

Shrink-swell potential is the relative change in volume of soil material to be expected with changes in moisture content, that is, the extent to which the soil shrinks as it dries out or swells when it gets wet. Extent of shrinking and swelling is influenced by the amount and kind of clay in the soil. Shrinking and swelling of soils cause much damage to building foundations, roads, and other structures. A *high* shrink-swell potential indicates a hazard to the maintenance of structures built in, on, or with material that has this rating.

Hydrologic soil group classifies the soils into four groups according to their infiltration and transmission rates. The groups are designated A (low runoff potential), B, C, and D (high runoff potential) (*11*).

Interpretations for the corrosivity to uncoated steel and concrete are not shown in table 5. Most soils in the survey area have a high corrosivity to uncoated steel pipe and a medium corrosivity to concrete. Corrosivity pertains to potential soil-induced chemical action that dissolves or weakens uncoated steel or concrete. Rate of corrosion of uncoated steel is related to such soil properties as drainage, texture, total acidity, and electrical conductivity of the soil material. Corrosivity to concrete is influenced mainly by the content of sodium or magnesium sulfate, but also by soil texture and acidity. Installations of uncoated steel that intersect soil boundaries or soil horizons are more susceptible to corrosion than installations made entirely in one kind of soil or in one soil horizon.

Testing of soils for the soil properties related to corrosion of uncoated steel pipe and concrete is desirable to determine if there is a problem and to what degree.

Figure 7.—Depth to bedrock needs to be considered in areas of Minnequa loam if pipelines are to be installed.

Engineering interpretations

The interpretations in table 6 are based on the estimated engineering properties of soils shown in table 5, on test data for soils in this survey area and in others nearby or adjoining, and on the experience of engineers and soil scientists with the soils of the Pueblo Area. In table 6, summarized ratings of suitability of the soils are given for roadfill, sand and gravel, and topsoil. Soil ratings are indicated by the terms good, fair, and poor.

Good means that soil properties generally are favorable for the given use or, in other words, limitations are minor and easily overcome. *Fair* means that some soil properties are unfavorable but can be overcome or modified by special planning and design. *Poor* means that soil properties are so unfavorable and so difficult to correct or overcome that major soil reclamation, special design, or intensive maintenance are needed.

Road fill is soil material used in embankments for roads. The suitability ratings reflect the predicted performance of soil after it has been placed in an embankment that has been properly compacted and provided with adequate drainage, and the relative ease of excavating the material at borrow areas.

Sand and gravel are used in great quantities in many kinds of construction. The ratings in table 6 provide guidance about where to look for probable sources. A soil rated as a *good* or *fair* source generally has a layer of sand or gravel at least 3 feet thick, the top of which is within a depth of 6 feet. The ratings do not take into account thickness of overburden, location of the water table, or other factors that affect mining of the material. Neither do they indicate the quality of the deposit.

Topsoil is used for topdressing an area where vegetation is to be established and maintained. Suitability is affected mainly by ease of working and spreading the soil material, as in preparing a seedbed; natural fertility of the material, or plant response when fertilizer is added to the soil; and absence of substances toxic to plants. Texture of the soil material and its content of stone fragments affect suitability. Also considered in the ratings is damage that can result at the area from which topsoil is taken.

TABLE 6.—*Engineering*

[Some terms used in this table

Series and mapping units	Suitability as source of—		
	Road fill	Sand and gravel	Topsoil
Absted: Ab	Fair: low strength; shrink-swell.	Unsuited	Fair: too clayey; excess alkali
Adena: Am For Manvel part, see Manvel series.	Fair: low strength	Unsuited	Good
Apishapa: Ap	Poor: wet; shrink-swell	Unsuited [1]	Poor: wet; too clayey
Arvada: AR For Keyner part, see Keyner series.	Severe: shrink-swell; low strength.	Unsuited	Poor: thin layer; excess alkali.

See footnote at end of table.

Soil features that affect pond reservoir areas and other uses are also given in table 6. These areas hold water behind a dam or embankment. Soils suitable for pond reservoir areas have low seepage, which is related to their permeability and the depth to fractured or permeable bedrock or other permeable material.

Embankments require soil material that is resistant to seepage and piping and that is of favorable stability, shrink-swell potential, shear strength, and compactibility. Stones or organic material in a soil are among the factors that are unfavorable for this use.

Irrigation of a soil is affected by such features as slope; susceptibility to stream overflow, erosion, or soil blowing; soil texture; content of stones; accumulation of salts and alkali; depth of root zone; rate of water intake at the surface; permeability below the surface layer and in fragipans or other layers that restrict movement of water; amount of water held available to plants; and need for drainage, or depth to water table or bedrock.

Terraces and diversions are embankments, or ridges, constructed across the slope to intercept runoff so that it soaks into the soil or flows slowly to a prepared outlet. Features that affect suitability of a soil for terraces are uniformity and steepness of slope, depth to bedrock or to other unfavorable material, presence of stones, permeability, and resistance to erosion, soil slipping, and soil blowing. A soil that is suitable for these structures provides outlets for runoff and is not difficult to vegetate.

Grassed waterways are sodded areas used to convey water and thus protect against erosion. Features that effect the establishment of grassed waterways are the establishment, growth, and maintenance of vegetation and the ease of layout and construction.

Land Use Planning

The estimated interpretations in table 7 are based on the engineering properties of soils shown in table 5, on test data for soils in this survey area and in other areas nearby or adjoining, and on the experience of engineers and soil scientists with the soils of the Pueblo Area. In table 7, ratings are used to summarize limitations of the soils for septic tank absorption fields, sewage lagoons, shallow excavations, dwellings, sanitary landfill, local streets and roads, playgrounds, picnic areas, camp areas, and paths and trails.

The degrees of soil limitation are indicated by the terms slight, moderate, and severe. *Slight* means that soil properties generally are favorable for the specified use, or that the limitations are minor and easily overcome. *Moderate* means that some soil properties are not favorable but can be overcome or modified by special planning and design. *Severe* means that soil properties are so unfavorable and so difficult to correct or overcome that major soil reclamation and special design are required.

Following are explanations of some of the column heads in table 7.

Septic tank absorption field is a subsurface system of tile or perforated pipe that distributes effluent from a septic tank into natural soil. The soil material from a depth of 18 inches to 6 feet is evaluated. The soil properties considered are those that affect both absorption of effluent and construction and operation of the system. Properties that affect absorption are permeability, depth to water table or rock, and susceptibility to flooding. Slope affects layout and construction and also the risk of soil erosion, lateral seepage, and downslope flow of effluent. Large rocks or boulders increase construction costs.

Sewage lagoons are shallow ponds constructed to hold sewage within a depth of 2 to 5 feet long enough for bacteria to decompose the solids. A lagoon has a nearly level floor. Its sides, or embankments, are of soil material compacted to medium density, and the pond is protected from flooding. Properties that affect the pond floor are permeability, organic matter, and slope, and if the floor needs to be leveled, depth to bedrock is important. The soil properties that affect the embankment are the engineering properties of the embankment material as interpreted from the Unified soil classification and the amount of stones, if any, that influence the ease of excavation and compaction of the embankment material.

Shallow excavations are those that require digging or trenching to a depth of less than 6 feet, for example,

interpretations

are defined in the Glossary]

Soil features affecting use for—				
Pond reservoir areas	Embankments	Irrigation	Terraces and diversions	Grassed waterways
Slope	Low strength; erodes easily; compressible.	Excess alkali; slope; erodes easily.	Erodes easily; percs slowly.	Erodes easily; percs slowly; slope.
Seepage; slope	Low strength; piping	Slope; erodes easily	Piping; erodes easily	Slope.
Favorable	Low strength; shrink-swell; compressible.	Percs slowly; wet	Percs slowly; wet	Percs slowly; wet.
Favorable	Low strength; shrink-swell.	Percs slowly; excess alkali.	Percs slowly	Excess alkali; percs slowly.

TABLE 6.—*Engineering*

Series and mapping units	Suitability as source of—		
	Road fill	Sand and gravel	Topsoil
Baca: Bc	Poor: low strength; shrink-swell.	Unsuited	Fair: too clayey
Bankard: Bk	Good	Fair for sand: excess fines. Unsuited to gravel.[1]	Poor: too sandy
Bloom: Bm	Poor: wet	Unsuited	Poor: wet; excess salt
Cascajo: CaE, CsE. Shale outcrop part of CsE too variable; no interpretations made.	Good where slope is 5 to 15 percent. Fair where slope is 15 to 25 percent. Poor where slope is more than 25 percent.	Good	Poor: small stones; too sandy; slope, where it is more than 15 percent.
Denver: DeD	Poor: shrink-swell; low strength.	Unsuited	Poor: too clayey
Dwyer: Dw	Good	Fair for sand: excess fines. Unsuited to gravel.	Poor: too sandy
Eutroboralfs: EBF. Too variable to estimate.			
Gilcrest: GcA, GeD, GfC	Good	Fair: excess fines	Poor: small stones
Glenberg: Gh. For Haverson part, see Haverson series.	Good	Poor for sand:[1] excess fines. Unsuited to gravel.[1]	Good
Haverson: Ha	Fair: low strength	Unsuited [1]	Good
Heldt: He	Poor: shrink-swell; low strength.	Unsuited	Poor: too clayey
Holderness: Ho	Poor: shrink-swell; low strength.	Unsuited	Fair: thin layer; slope, where it is more than 8 percent.
Keyner: Ke	Fair: wet	Poor for sand: excess fines. Unsuited to gravel.	Poor: excess alkali
Keyner part of AR	Fair: low strength	Poor for sand: excess fines. Unsuited to gravel.	Poor: excess alkali
Kim: Km	Fair: low strength	Unsuited	Good
LaPorte: LaE	Poor: thin layer	Unsuited	Poor: thin layer; small stones
Larkson: LbD	Poor: shrink-swell; low strength.	Unsuited	Fair: thin layer; too clayey; slope, where it is 8 to 15 percent.
LcE	Fair: frost action; low strength.	Unsuited	Fair: too clayey; large stones
Las Animas: Lm	Poor: wet	Poor for sand. Unsuited to gravel.[1]	Fair: excess salts
Limon: LnA, LnB, LoA, LvB	Poor: shrink-swell	Unsuited	Poor: too clayey
Manvel: MaA, MaB, Mg	Fair: low strength	Unsuited	Fair: excess lime; area reclaim
Mn	Fair: low strength	Unsuited	Fair: excess lime; excess salts
Manzanola: MoD	Poor: shrink-swell; low strength.	Unsuited	Fair: thin layer
MpA	Poor: shrink-swell	Unsuited	Fair: thin layer
Midway: MsD. Shale outcrop part too variable, no interpretations made.	Poor: shrink-swell; thin layer	Unsuited	Poor: thin layer; too clayey
Minnequa: Mv. For Manvel part, see Manvel series.	Poor: thin layer	Unsuited	Fair: excess lime; thin layer; too clayey.
Mortenson. Mapped only with Wetmore soils.	Poor: slope; large stones	Poor: excess fines	Poor: large stones; slope

See footnote at end of table.

interpretations—Continued

Soil features affecting use for—				
Pond reservoir areas	Embankments	Irrigation	Terraces and diversions	Grassed waterways
Favorable	Low strength; compressible.	Favorable	Favorable	Favorable.
Seepage	Piping; seepage; erodes easily.	Droughty; floods; seepage.	Erodes easily; piping	Droughty; erodes easily.
Favorable	Compressible; low strength.	Wet; floods; excess salt	Wet	Wet.
Seepage; slope	Seepage	Droughty; seepage; complex slope.	Complex slope; too sandy.	Droughty; slope.
Slope	Shrink-swell; compressible; low strength.	Slope; percs slowly	Percs slowly; slope	Percs slowly; slope.
Seepage; slope	Piping; seepage	Complex slope; erodes easily.	Complex slope, erodes easily.	Erodes easily; slope.
Seepage	Favorable	Slope; droughty; seepage	Complex slope	Droughty; slope.
Seepage	Piping; erodes easily	Floods; soil blowing	Erodes easily	Favorable.
Seepage	Low strength; compressible; erodes easily.	Floods; soil blowing	Erodes easily	Favorable.
Slope	Low strength; piping; shrink-swell.	Percs slowly; slow intake; slope.	Erodes easily; percs slowly; piping.	Erodes easily; percs slowly.
Slope	Shrink-swell; low strength; compressible.	Percs slowly; slope	Percs slowly; complex slope.	Percs slowly; slope.
Seepage; slope	Low strength; piping	Excess alkali; slope	Erodes easily; poor outlets.	Excess alkali; erodes easily.
Slope; seepage	Low strength; piping	Slope; excess alkali; percs slowly.	Erodes easily	Excess alkali; erodes easily.
Seepage; slope where it is 2 to 5 percent.	Piping; low strength	Slope	Slope; piping	Slope.
Depth to rock; slope	Thin layer	Droughty; rooting depth; slope.	Depth to rock; rooting depth; slope.	Rooting depth; slope; droughty.
Slope	Shrink-swell; low strength.	Slope; erodes easily; percs slowly.	Erodes easily; slope; percs slowly.	Erodes easily; slope; percs slowly.
Slope	Low strength; large stones; shrink-swell.	Slope; erodes easily; percs slowly.	Complex slope; large stones; erodes easily.	Erodes easily; large stones; percs slowly.
Seepage	Piping	Floods; wet	Wet; piping	Wet.
Favorable	Low strength; piping; shrink-swell.	Percs slowly; slope; excess salts.	Percs slowly; piping	Percs slowly; excess salts.
Slope	Erodes easily; low strength.	Erodes easily; slope; excess lime.	Erodes easily	Erodes easily.
Favorable	Erodes easily; low strength.	Excess lime; wet; excess salts.	Wet	Wet; excess salts.
Slope	Shrink-swell; compressible.	Percs slowly; slope	Percs slowly; slope	Percs slowly; slope.
Favorable	Shrink-swell; compressible.	Percs slowly	Percs slowly	Percs slowly.
Slope; depth to rock	Thin layer; shrink-swell	Rooting depth; slow intake; complex slope.	Slope; rooting depth; depth to rock.	Rooting depth; slope.
Depth to rock; seepage; slope.	Thin layer; low strength; piping.	Rooting depth; slope; erodes easily.	Depth to rock; rooting depth.	Erodes. easily.
Slope	Large stones; low strength.	Slope; complex slope	Complex slope; large stones.	Slope; large stones.

TABLE 6.—*Engineering*

Series and mapping units	Suitability as source of—		
	Road fill	Sand and gravel	Topsoil
Nederland: NdE	Poor: large stones	Fair: excess fines	Poor: large stones; slope, where it is more than 15 percent.
Neville: NeD	Fair: low strength	Unsuited	Good
Nunn:			
NnD	Poor: shrink-swell; low strength.	Unsuited	Fair: large stones; thin layer
NuC, NuD	Poor: shrink-swell; low strength.	Unsuited	Fair: thin layer; slope, where it is more than 8 percent.
Olney: Oe, Of	Fair: low strength	Unsuited	Good for Of Poor for Oe: too sandy.
Otero:			
OoA, OoC, OrD	Good	Poor for sand. Unsuited to gravel.[1]	Good
OtA, OtB	Fair: low strength	Poor for sand. Unsuited to gravel.[1]	Good
Penrose: PmE, PrF For Minnequa part of PmE, see Minnequa series. Rock outcrop part of PrF is too variable; no interpretations made.	Poor: thin layer; slope, where it is more than 15 percent.	Unsuited	Poor: area reclaim; thin layer; small stones; slope, where it is more than 15 percent.
Pinata: PW For Wetmore part, see Wetmore series.	Poor: shrink-swell; slope	Unsuited	Poor: large stones; slope
Razor: Ra, Re2	Poor: shrink-swell; low strength; thin layer.	Unsuited	Poor: too clayey
Rocky Ford:			
RfA, RfB	Fair: low strength	Unsuited [1]	Good
Rg	Fair: low strength	Unsuited [1]	Good
Schamber: SaE	Good if slope is 5 to 15 percent Fair if slope is 15 to 25 percent.	Fair: excess fines	Poor: too sandy; small stones
Shingle: SgD	Poor: thin layer	Unsuited	Poor: thin layer
Stoneham: Sh	Fair: low strength	Unsuited	Good
Stroupe: StE	Poor: thin layer; large stones; slope, where it is 15 to 25 percent.	Unsuited	Poor: large stones; thin layer; slope, where it is 15 to 25 percent.
Table Mountain: TM	Fair: low strength	Unsuited	Good
Travessilla: ToD, TrG Rock outcrop part of TrG is too variable; no interpretations made.	Poor: thin layer; area reclaim	Unsuited	Poor: thin layer; area reclaim
Valent: Va	Good	Fair for sand: excess fines. Unsuited to gravel.	Poor: too sandy
Vamer: VmE Rock outcrop part too variable, no interpretations made.	Poor: thin layer; area reclaim	Unsuited	Poor: thin layer; large stones; area reclaim.
Vona: Vn, Vo, Vs2 For Otero part of Vs2, see Otero series.	Fair: low strength	Poor for sand: excess fine. Unsuited to gravel	Good in Vo. Poor in Vn, Vs2; too sandy.
Wetmore: WE For Mortenson part, see Mortenson series.	Poor: thin layer; slope	Unsuited	Poor: small stones; slope
Wiley: Wk For Kim part, see Kim series.	Fair: low strength; slope is 0 to 15 percent.	Unsuited	Good
Wormser: Wo	Poor: low strength; area reclaim; thin layer.	Unsuited	Poor: too clayey; area reclaim.

[1] Sand and gravel are below a depth of 60 inches in places.

interpretations—Continued

Soil features affecting use for—				
Pond reservoir areas	Embankments	Irrigation	Terraces and diversions	Grassed waterways
Slope; seepage	Large stones; seepage	Slope; droughty	Large stones; complex slope; slope.	Large stones; slope; droughty.
Seepage; slope	Compressible; low strength.	Slope; erodes easily	Slope; erodes easily	Slopes; erodes easily.
Slope	Large stones; compressible; shrink-swell.	Slope; percs slowly	Percs slowly; large stones.	Large stones; percs slowly; slope.
Slope	Compressible; shrink-swell; low strength.	Slope; percs slowly	Percs slowly	Percs slowly; slope.
Seepage; slope	Piping; low strength.	Erodes easily; slope	Erodes easily; piping	Erodes easily.
Seepage; slope	Piping	Slope; erodes easily; seepage.	Erodes easily; slope; piping.	Erodes easily; slope.
Seepage	Low strength; piping	Droughty; slow intake	Piping	Droughty.
Depth to rock; slope; seepage.	Thin layer	Slope; depth to rock	Depth to rock; slope	Rooting depth; droughty; slope.
Slope	Low strength; hard to pack; shrink-swell.	Slope; percs slowly	Percs slowly; slope	Slope; large stones.
Depth to rock; slope	Low strength; compressible; shrink-swell.	Slope; slow intake	Percs slowly; slope	Percs slowly; slope.
Seepage	Compressible; erodes easily.	Slope	Erodes easily	Favorable.
Seepage	Compressible; erodes easily.	Wet; floods; excess salts	Erodes easily	Wet; excess salts.
Slope; seepage	Seepage; hard to pack	Slope; droughty; fast intake.	Too sandy; slope	Droughty; slope.
Slope	Erodes easily; shrink-swell.	Rooting depth; slow intake; slope.	Complex slope; erodes easily; depth to rock; rooting depth.	Erodes easily; depth to rock; rooting depth.
Seepage; slope	Low strength; compressible.	Slope	Slope	Slope.
Depth to rock; slope	Thin layer; low strength; hard to pack.	Slope; rooting depth	Depth to rock; slope; large stones.	Slope; rooting depth; large stones.
Seepage; slope	Low strength; compressible.	Slope; erodes easily	Erodes easily	Erodes easily; slope.
Depth to rock; seepage	Depth to rock	Rooting depth; slope	Depth to rock; complex slope; slope.	Rooting depth; slope.
Seepage; slope	Piping; seepage	Complex slope; erodes easily; droughty.	Complex slope; erodes easily.	Erodes easily; slope; droughty.
Depth to rock	Thin layer; shrink-swell	Rooting depth; slope	Depth to rock; large stones; slope.	Rooting depth; large stones; slope.
Seepage; slope	Piping; erodes easily	Fast intake; seepage; slope.	Piping; erodes easily	Erodes easily; droughty.
Slope; seepage	Thin layer	Slope; rooting depth; fast intake.	Slope; depth to rock	Slope; rooting depth; droughty.
Slope; seepage	Piping; low strength	Slope; erodes easily	Piping; erodes easily	Erodes easily.
Slope; depth to rock	Low strength; shrink-swell.	Percs slowly; slope; rooting depth.	Depth to rock; percs slowly; slope.	Slope; percs slowly; rooting depth.

TABLE 7.—*Interpretations of the soils for*

[Some terms used in this table

Series and map symbols	Septic tank absorption field	Sewage lagoons	Shallow excavations	Dwellings with basements	Dwellings without basements
Absted: Ab	Severe: percs slowly.	Slight where slope is 0 to 2 percent. Moderate where slope is 2 to 3 percent.	Slight	Moderate: low strength; shrink-swell.	Moderate: low strength; shrink-swell.
Adena: Am. For Manvel part, see Manvel series.	Moderate: percs slowly.	Moderate: seepage; slope of 2 to 3 percent.	Slight	Moderate: low strength.	Moderate: low strength.
Apishapa: Ap	Severe: percs slowly; wet; floods.	Severe: wet; floods.	Severe: wet; too clayey; floods.	Severe: floods; wet; shrink-swell.	Severe: floods; wet; shrink-swell.
Arvada: AR. For Keyner part, see Keyner series	Severe: percs slowly.	Slight	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.
Baca: Bc	Moderate: percs slowly.	Slight	Slight	Moderate: low strength; shrink-swell.	Moderate: low strength; shrink-swell.
Bankard: Bk	Severe: floods; seepage.	Severe: cutbanks cave; floods.	Severe: floods	Severe: floods	Severe: floods
Bloom: Bm	Severe: wet; percs slowly; floods.	Severe: wet; floods.	Severe: wet; floods.	Severe: wet; floods.	Severe: wet; floods; frost action.
Cascajo: CaE, CsE. Shale outcrop part of CsE is too variable for interpretations to be made.	Slight where slope is 5 to 8 percent. Moderate where slope is 8 to 15 percent. Severe where slope is more than 15 percent.	Severe: seepage; small stones; slope of more than 7 percent.	Severe: small stones; cutbanks cave; slope of more than 15 percent.	Slight where slope is 5 to 8 percent. Moderate where slope is 8 to 15 percent. Severe where slope is more than 15 percent.	Slight where slope is 5 to 8 percent. Moderate where slope is 8 to 15 percent. Severe where slope is more than 15 percent.
Denver: DeD	Severe: percs slowly.	Moderate where slope is 3 to 7 percent. Severe where slope is more than 7 percent.	Severe: too clayey	Severe: shrink-swell.	Severe: shrink-swell.
Dwyer: Dw [2]	Slight [3]	Severe: seepage	Severe: too sandy; cutbanks cave.	Slight	Slight
Eutroboralfs: EBF. Too variable for interpretations to be made.					
Gilcrest: GcA, GeD, GfC.[2]	Slight [3]	Severe: seepage	Severe: cutbanks cave.	Slight	Slight
Glenberg: Gh. For Haverson part, see Haverson series.	Severe: floods	Severe: floods; seepage.	Severe: floods	Severe: floods	Severe: floods
Haverson: Ha	Severe: floods	Severe: floods	Severe: floods	Severe: floods	Severe: floods

See footnotes at end of table.

land use planning and recreation

are defined in the Glossary]

Sanitary landfill [1]		Streets and roads	Playgrounds	Picnic areas	Camp areas	Paths and trails
Trench	Area					
Moderate: too clayey.	Slight	Moderate: low strength; shrink-swell.	Moderate: dusty; too clayey; slope of 2 to 3 percent.	Moderate: dusty; too clayey.	Moderate: dusty; too clayey.	Moderate: dusty; too clayey.
Slight	Slight	Moderate: low strength.	Moderate: dusty; slope of 2 to 6 percent.	Moderate: dusty.	Moderate: percs slowly; dusty.	Moderate: dusty.
Severe: wet; floods; too clayey.	Severe: wet; floods.	Severe: floods; wet; shrink-swell.	Severe: floods; too clayey; dusty.	Severe: floods; too clayey; dusty.	Severe: floods; too clayey; dusty.	Moderate: dusty.
Moderate: too clayey.	Slight	Severe: shrink-swell; low strength.	Severe: percs slowly.	Moderate: dusty.	Severe: percs slowly; dusty.	Moderate: dusty.
Moderate: too clayey.	Slight	Moderate: low strength; shrink-swell.	Moderate: dusty.	Moderate: dusty.	Moderate: dusty.	Moderate: dusty.
Severe: floods; seepage.	Severe: floods	Severe: floods	Severe: floods	Moderate: floods; too sandy.	Severe: floods	Severe: too sandy.
Severe: wet; floods.	Severe: floods	Severe: wet; floods; frost action.	Severe: wet; floods.	Moderate: wet; floods.	Severe: wet; floods.	Moderate: wet.
Severe: seepage; too sandy.	Severe: seepage; slope of more than 15 percent.	Slight where slope is 0 to 8 percent. Moderate where slope is 8 to 15 percent. Severe where slope is more than 15 percent.	Severe: small stones; slope of more than 6 percent.	Severe: small stones; slope of more than 15 percent.	Severe: small stones; slope of more than 15 percent.	Severe: small stones.
Severe: too clayey.	Slight where slope is 3 to 8 percent. Moderate where slope is 8 to 9 percent.	Severe: shrink-swell.	Moderate: percs slowly; too clayey; slope of 2 to 6 percent. Severe where slope is 6 to 9 percent.	Moderate: too clayey; percs slowly; slope of more than 8 percent.	Moderate: too clayey; percs slowly; slope of more than 8 percent.	Moderate: too clayey.
Severe: too sandy.	Slight	Slight	Severe: too sandy; slope of more than 6 percent.	Moderate where slope is 2 to 7 percent; too sandy.	Moderate where slope is 0 to 8 percent; too sandy.	Severe: too sandy.
Severe: too sandy; small stones.	Slight	Slight	Moderate: small stones; slope of 2 to 6 percent. Severe where slope is 6 to 9 percent.	Slight	Slight	Slight.
Severe: floods	Severe: floods	Severe: floods	Severe: floods	Moderate: floods.	Severe: floods	Slight.
Severe: floods	Severe: floods	Severe: floods	Severe: floods	Moderate: floods.	Severe: floods	Slight.

TABLE 7.—*Interpretations of the soils for*

Series and map symbols	Septic tank absorption field	Sewage lagoons	Shallow excavations	Dwellings with basements	Dwellings without basements
Heldt: He	Severe: percs slowly.	Moderate: slope	Severe: too clayey	Severe: shrink-swell; low strength.	Severe: shrink-swell; low strength.
Holderness: Ho	Severe: percs slowly.	Moderate where slope is 3 to 7 percent. Severe where slope is more than 7 percent.	Moderate: too clayey; slope of more than 8 percent.	Moderate: shrink-swell; slope of more than 8 percent.	Severe: shrink-swell.
Keyner: Ke	Severe: wet; floods.	Severe: wet; floods; seepage.	Severe: floods; wet	Severe: floods; wet	Severe: floods
Keyner part of AR.	Slight	Severe: seepage	Slight	Slight	Slight
Kim: Km	Slight [3]	Moderate: seepage; slope of 2 to 5 percent.	Slight	Moderate: low strength; slope of 0 to 5 percent.	Moderate: low strength; slope of 0 to 5 percent.
LaPorte: LaE	Severe: depth to rock; slope of more than 15 percent.	Severe: depth to rock; slope of more than 7 percent.	Severe: depth to rock; slope of more than 15 percent.	Severe: depth to rock; slope of more than 15 percent.	Severe: depth to rock; slope of more than 15 percent.
Larkson: LbD	Severe: percs slowly; slope of 6 to 12 percent.	Moderate where slope is 6 to 7 percent. Severe where slope is more than 7 percent.	Severe: too clayey; slope of 6 to 12 percent.	Severe: shrink-swell; slope of 6 to 12 percent.	Severe: shrink-swell; slope of 6 to 12 percent.
LcE	Moderate: percs slowly; large stones; slope of 8 to 15 percent. Severe where slope is more than 15 percent.	Moderate where slope is 5 to 7 percent. Severe where slope is more than 7 percent.	Moderate: large stones; too clayey; slope of 8 to 15 percent. Severe where slope is more than 15 percent.	Moderate: large stones; low strength; slope of 8 to 15 percent. Severe where slope is more than 15 percent.	Moderate: large stones; shrink-swell; slope of 8 to 15 percent. Severe where slope is more than 15 percent.
Las Animas: Lm	Severe: wet; floods.	Severe: wet; floods; seepage.	Severe: wet; floods.	Severe: wet; floods.	Severe: wet; floods.
Limon: LnA, Ln,B LoA, LvB. [4]	Severe: percs slowly.	Slight where slope is 0 to 2 percent. Moderate where slope is 2 to 5 percent.	Severe: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.
Manvel: MaA, MaB, Mg	Moderate: percs slowly; slope of 0 to 5 percent.	Moderate: seepage; slope of 0 to 5 percent.	Slight: slope of 0 to 5 percent.	Moderate: low strength; slope of 0 to 5 percent.	Moderate: low strength; slope of 0 to 5 percent.
Mn	Moderate: wet	Moderate: wet	Moderate: wet	Moderate: low strength.	Moderate: low strength.

See footnotes at end of table.

land use planning and recreation—Continued

Sanitary landfill [1]		Streets and roads	Playgrounds	Picnic areas	Camp areas	Paths and trails
Trench	Area					
Severe: too clayey.	Slight	Severe: shrink-swell; low strength.	Severe: too clayey; percs slowly.	Severe: too clayey.	Severe: too clayey; percs slowly.	Severe: too clayey.
Slight	Slight where slope is 3 to 8 percent. Moderate where slope is more than 8 percent.	Severe: shrink-swell.	Moderate where slope is 3 to 6 percent: percs slowly. Severe where slope is more than 6 percent.	Slight where slope is 3 to 8 percent. Moderate where slope is more than 8 percent.	Moderate: percs slowly; slope of more than 8 percent.	Slight.
Severe: wet; floods; seepage.	Severe: floods; wet.	Severe: floods	Moderate: floods; dusty; percs slowly.	Moderate: floods; dusty.	Severe: floods	Slight.
Severe: seepage	Slight	Moderate: low strength; shrink-swell.	Moderate: slope; too sandy; dusty.	Moderate: too sandy; dusty.	Moderate: too sandy; dusty.	Moderate: too sandy; dusty.
Slight	Slight: slope of 0 to 5 percent.	Moderate: low strength; slope of 0 to 8 percent.	Slight where slope is 0 to 2 percent. Moderate where slope is 2 to 5 percent.	Moderate: dusty; slope of 0 to 5 percent.	Moderate: dusty.	Slight.
Severe: depth to rock; slope of more than 25 percent.	Slight where slope is 3 to 8 percent. Moderate where slope is 8 to 15 percent. Severe where slope is more than 15 percent.	Severe: depth to rock; slope of more than 15 percent.	Severe: depth to rock; slope of more than 6 percent.	Slight where slope is 3 to 8 percent. Moderate where slope is 8 to 15 percent. Severe where slope is more than 15 percent.	Slight where slope is 3 to 8 percent. Moderate where slope is 8 to 15 percent. Severe where slope is more than 15 percent.	Slight where slope is 3 to 15 percent. Moderate where slope is 15 to 25 percent.
Severe: too clayey; slope of 6 to 12 percent.	Slight where slope is 6 to 8 percent. Moderate where slope is 8 to 12 percent.	Severe: shrink-swell; slope of 6 to 12 percent.	Severe: slope is more than 6 percent.	Moderate: too sandy; slope of 8 to 12 percent.	Moderate: too sandy; slope of 8 to 12 percent.	Slight.
Moderate: large stones; slope of more than 15 percent.	Slight where slope is 5 to 8 percent. Moderate where slope is 8 to 15 percent. Severe where slope is more than 15 percent.	Moderate: frost action; shrink-swell; slope of 8 to 15 percent. Severe where slope is more than 15 percent.	Moderate where slope is 5 to 6 percent: large stones. Severe where slope is more than 6 percent.	Slight where slope is 5 to 8 percent. Moderate where slope is 8 to 15 percent. Severe where slope is more than 15 percent.	Moderate: large stones; slope where it is 8 to 15 percent. Severe where slope is more than 15 percent.	Moderate where slope is 5 to 15 percent: large stones. Severe where slope is 15 to 25 percent.
Severe: wet; floods; seepage.	Severe: wet; floods.	Severe: floods; wet; frost action.	Severe: wet; floods.	Severe: wet	Severe: floods; wet.	Severe: wet.
Severe: too clayey.	Slight	Severe: shrink-swell.	Severe: too clayey.	Severe: too clayey.	Severe: too clayey.	Moderate: too clayey.
Slight	Slight	Moderate: low strength.	Moderate: dusty; slope of 2 to 5 percent.	Moderate: dusty.	Moderate: dusty.	Moderate: dusty.
Severe: wet	Moderate: wet	Moderate: low strength; slope of 0 to 5 percent.	Moderate: dusty.	Moderate: dusty.	Moderate: dusty.	Moderate: dusty.

TABLE 7.—*Interpretations of the soils for*

Series and map symbols	Septic tank absorption field	Sewage lagoons	Shallow excavations	Dwellings with basements	Dwellings without basements
Manzanola: MoD	Severe: percs slowly.	Moderate where slope is 2 to 7 percent. Severe where slope is more than 7 percent.	Moderate: too clayey; slope of 2 to 8 percent.	Moderate: shrink-swell; slope of 2 to more than 8 percent.	Severe: shrink-swell.
MpA	Severe: percs slowly.	Severe: floods	Moderate: floods	Severe: floods	Severe: floods
Midway: MsD Shale outcrop part is too variable for interpretations to be made.	Severe: percs slowly.	Severe: depth to rock; slope of more than 7 percent.	Severe: too clayey; depth to rock.	Severe: shrink-swell; depth to rock.	Severe: too clayey; depth to rock.
Minnequa: Mv For Manvel part, see Manvel series.	Severe:[5] depth to rock.	Severe:[6] depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Moderate: depth to rock.
Mortenson Mapped only with Wetmore soils.	Severe: slope; large stones.	Severe: slope; large stones.	Severe: slope; large stones.	Severe: slope; large stones.	Severe: slope; large stones.
Nederland: NdE	Severe: large stones; slope of more than 15 percent.	Severe: large stones; seepage; slope.	Severe: large stones; slope of more than 15 percent.	Severe: large stones; slope of more than 15 percent.	Severe: large stones; slope of more than 15 percent.
Neville: NeD	Slight where slope is 5 to 8 percent. Moderate where slope is 8 to 9 percent.	Moderate where slope is 3 to 7 percent: seepage. Severe where slope is more than 7 percent.	Slight where slope is 3 to 8 percent. Moderate where slope is 8 to 9 percent.	Slight where slope is 3 to 8 percent. Moderate where slope is 8 to 9 percent.	Slight where slope is 0 to 8 percent. Moderate where slope is 8 to 9 percent.
Nunn: NnD	Severe: percs slowly; large stones.	Moderate where slope is 3 to 7 percent. Severe where slope is more than 7 percent.	Moderate: large stones; too clayey; slope of 8 to 9 percent.	Moderate: large stones; shrink-swell; slope of 8 to 9 percent.	Moderate: large stones; shrink-swell; slope of 3 to 8 percent.
NuC, NuD	Severe: percs slowly.	Slight where slope is 0 to 2 percent. Moderate where slope is 2 to 7 percent. Severe where slope is more than 7 percent.	Moderate: too clayey; shrink-swell; slope of 8 to 9 percent.	Moderate: shrink-swell; slope of 8 to 9 percent.	Severe: shrink-swell.
Olney: Oe, Of	Slight	Moderate: seepage; slope of 2 to 5 percent.	Slight	Slight	Slight

See footnotes at end of table.

land use planning and recreation—Continued

Sanitary landfill [1]		Streets and roads	Playgrounds	Picnic areas	Camp areas	Paths and trails
Trench	Area					
Moderate: too clayey.	Slight where slope is 2 to 8 percent. Moderate where slope is 8 to 9 percent.	Severe: shrink-swell.	Moderate: percs slowly; slope of 2 to 6 percent. Severe where slope is more than 6 percent.	Moderate: too clayey.	Moderate: percs slowly; slope of 2 to more than 8 percent.	Moderate: too clayey.
Moderate: floods.	Moderate: floods.	Severe: shrink-swell.	Moderate: too clayey; floods; percs slowly.	Moderate: too clayey; floods.	Moderate: percs slowly; too clayey.	Moderate: too clayey.
Severe: too clayey; depth to rock.	Slight where slope is 1 to 8 percent. Moderate where slope is more than 8 percent.	Severe: shrink-swell; low strength; depth ro rock.	Severe: depth to rock.	Moderate: too clayey; slope of 8 to 9 percent.	Severe: percs slowly.	Severe: too clayey.
Severe: depth to rock.	Slight	Moderate: low strength.	Moderate: depth to rock; dusty; slope of 2 to 3 percent.	Moderate: dusty.	Moderate: dusty.	Moderate: dusty.
Severe: slope; large stones.	Severe: slope; large stones.	Severe: slope; large stones.	Severe: slope; large stones.	Severe: slope; large stones.	Severe: slope; large stones.	Severe: slope; large stones.
Severe: large stones; seepage.	Moderate where slope is 9 to 15 percent. Severe where slope is more than 15 percent.	Moderate where slope is 9 to 15 percent: large stones. Severe where slope is more than 15 percent.	Severe: large stones; slope.	Severe: large stones; slope of more than 15 percent.	Severe: large stones; slope of more than 15 percent.	Severe: large stones.
Slight	Slight where slope is 3 to 8 percent. Moderate where slope is 8 to 9 percent.	Moderate: low strength; slope of 8 to 9 percent.	Moderate where slope is 3 to 6 percent. Severe where slope is more than 6 percent.	Slight where slope is 3 to 8 percent. Moderate where slope is 8 to 9 percent.	Slight where slope is 3 to 8 percent. Moderate where slope is 8 to 9 percent.	Slight.
Moderate: large stones; too clayey.	Slight	Moderate: shrink-swell; large stones.	Moderate where slope is 3 to 6 percent: large stones. Severe where slope is more than 6 percent.	Slight where slope is 3 to 8 percent. Moderate where slope is 8 to 9 percent.	Slight where slope is 3 to 8 percent. Moderate where slope is 8 to 9 percent.	Slight.
Slight	Slight	Severe: shrink-swell.	Moderate: percs slowly; slope of 2 to 6 percent. Severe where slope is more than 6 percent.	Moderate: too clayey.	Moderate: percs slowly; slope of 8 to 9 percent.	Moderate: too clayey.
Slight	Slight	Slight	Slight where slope is 0 to 2 percent. Moderate where slope is 2 to 3 percent.	Slight	Slight	Slight.

TABLE 7.—*Interpretations of the soils for*

Series and map symbols	Septic tank absorption field	Sewage lagoons	Shallow excavations	Dwellings with basements	Dwellings without basements
Otero: OoA, OoC, OrD	Slight where slope is 6 to 8 percent. Moderate where slope is 8 to 9 percent.	Severe: seepage; slope of 7 to 9 percent.	Slight where slope is 0 to 8 percent. Moderate where slope is 8 to 9 percent.	Slight where slope is 0 to 8 percent. Moderate where slope is 8 to 9 percent.	Slight where slope is 0 to 8 percent. Moderate where slope is 8 to 9 percent.
OtA, OtB	Slight	Severe: seepage	Slight	Slight	Slight
Penrose: PmE, PrF For Minnequa part of PmE, see Minnequa series; Rock outcrop part of PrF is too variable for interpretations to be made.	Severe:[5] depth to rock; slope of more than 15 percent.	Severe: depth to rock; slope of more than 7 percent.	Severe: depth to rock; slope of more than 15 percent.	Severe: depth to rock; slope, where it is more than 15 percent.	Severe: depth to rock; slope of more than 15 percent.
Pinata: PW For Wetmore part, see Wetmore series.	Severe: slope; percs slowly.	Severe: large stones; slope.	Severe: slope	Severe: slope; shrink-swell.	Severe: slope; shrink-swell.
Razor: Ra, Re2	Severe: percs slowly; depth to rock.	Severe:[6] depth to rock.	Moderate: depth to rock.	Severe: shrink-swell.	Severe: shrink-swell.
Rocky Ford: RfA, RfB	Moderate: percs slowly.	Moderate: seepage	Slight	Moderate: low strength.	Moderate: low strength.
Rg	Severe: floods	Severe: floods	Severe: floods	Severe: floods	Severe: floods
Schamber: SaE	Slight [3] where slope is 5 to 8 percent. Moderate where slope is 8 to 15 percent. Severe where slope is more than 15 percent.	Severe: seepage	Severe: cutbanks cave.	Slight where slope is 5 to 8 percent. Moderate where slope is 8 to 15 percent. Severe where slope is more than 15 percent.	Slight where slope is 5 to 8 percent. Moderate where slope is 8 to 15 percent. Severe where slope is more than 15 percent.
Shingle: SgD	Severe: depth to rock.	Severe:[6] depth to rock; slope of more than 7 percent.	Moderate: depth to rock; slope, where it is 8 to 9 percent.	Severe: depth to rock.	Moderate: depth to rock; shrink-swell; slope of 8 to 9 percent.
Stoneham: Sh	Slight	Moderate: seepage; slope of 2 to 3 percent.	Slight	Slight	Slight
Stroupe: StE	Severe: depth to rock; percs slowly; slope of more than 15 percent.	Severe: large stones; depth to rock; slope.	Severe: depth to rock; large stones; slope of more than 15 percent.	Severe: depth to rock; slope of more than 15 percent.	Moderate where slope is 9 to 15 percent: depth to rock; shrink-swell. Severe where slope is more than 15 percent.

See footnotes at end of table.

land use planning and recreation—Continued

Sanitary landfill [1]		Streets and roads	Playgrounds	Picnic areas	Camp areas	Paths and trails
Trench	Area					
Slight	Slight where slope is 0 to 8 percent. Moderate where slope is 8 to 9 percent.	Slight where slope is 0 to 8 percent. Moderate where slope is 8 to 9 percent.	Slight where slope is 0 to 2 percent. Moderate where slope is 2 to 6 percent. Severe where slope is more than 6 percent.	Slight where slope is 0 to 8 percent. Moderate where slope is 8 to 9 percent.	Slight where slope is 0 to 8 percent. Moderate where slope is 8 to 9 percent.	Slight.
Slight	Slight	Slight	Severe: dusty	Severe: dusty	Severe: dusty	Severe: dusty.
Severe: depth to rock; slope of more than 25 percent.	Slight where slope is 1 to 8 percent. Moderate where slope is 8 to 15 percent. Severe where slope is more than 15 percent.	Severe: depth to rock; shape of more than 15 percent.	Severe: small stones; depth to rock; slope of more than 6 percent.	Moderate where slope is 1 to 15 percent: small stones. Severe where slope is more than 15 percent.	Moderate where slope is 1 to 15 percent: small stones. Severe where slope is more than 15 percent.	Moderate where slope is 1 to 25 percent: small stones. Severe where slope is more than 25 percent.
Severe: slope; large stones.	Severe: slope	Severe: slope; shrink-swell.	Severe: slope; large stones.	Severe: large stones; slope.	Severe: large stones; slope.	Severe: slope.
Severe: too clayey; depth to rock.	Slight	Severe: shrink-swell.	Severe: too clayey.	Severe: too clayey.	Severe: too clayey.	Severe: too clayey.
Slight	Slight	Moderate: low strength.	Severe: dusty	Severe: dusty	Severe: dusty	Severe: dusty.
Severe: floods	Severe: floods	Moderate: floods; shrink-swell; frost action.	Severe: dusty	Severe: dusty	Severe: dusty	Severe: dusty.
Severe: seepage.	Severe: seepage.	Slight where slope is 5 to 8 percent. Moderate where slope is 8 to 15 percent. Severe where slope is more than 15 percent.	Moderate where slope is 5 to 6 percent: small stones. Severe where slope is more than 6 percent.	Slight where slope is 5 to 8 percent. Moderate where slope is 8 to 15 percent. Severe where slope is more than 15 percent.	Slight where slope is 5 to 8 percent. Moderate where slope is 8 to 15 percent. Severe where slope is more than 15 percent.	Slight where slope is 0 to 15 percent. Moderate where slope is 15 to 25 percent.
Severe: depth to rock.	Slight where slope is less than 8 percent. Moderate where slope is 8 to 9 percent.	Moderate: depth to rock; shrink-swell; slope of 8 to 9 percent.	Moderate where slope is 1 to 6 percent: too clayey; dusty. Severe where slope is more than 6 percent.	Moderate: dusty; too clayey; slope of 8 to 9 percent.	Moderate: dusty; too clayey; slope of 8 to 9 percent.	Moderate: too clayey; dusty.
Slight	Slight	Moderate: low strength.	Moderate: dusty; slope of 2 to 3 percent.	Moderate: dusty.	Moderate: dusty.	Moderate: dusty.
Severe: depth to rock; large stones.	Moderate where slope is 9 to 15 percent. Severe where slope is more than 15 percent.	Moderate where slope is 9 to 15 percent: depth to rock; shrink-swell. Severe where slope is more than 15 percent.	Severe: large stones; slope.	Severe: large stones.	Severe: large stones.	Severe: large stones.

TABLE 7.—*Interpretations of the soils for*

Series and map symbols	Septic tank absorption field	Sewage lagoons	Shallow excavations	Dwellings with basements	Dwellings without basements
Table Mountain: TM.	Slight	Moderate: seepage; slope of 1 to 2 percent.	Slight	Moderate: low strength.	Moderate: low strength.
Travessilla: ToD, TrG. Rock outcrop part is too variable for interpretations to be made.	Severe: depth to rock; slope of more than 15 percent.	Severe: depth to rock; slope of more than 7 percent.	Severe: depth to rock; slope of more than 15 percent.	Moderate where slope is 1 to 15 percent: low strength. Severe where slope is more than 15 percent: depth to rock.	Severe: depth to rock; slope of 1 to 15 percent.
Valent: Va [2]	Slight [3]	Severe: seepage	Severe: cutbanks cave.	Slight	Slight
Vamer: VmE. Rock outcrop part is too variable for interpretations to be made.	Severe: depth to rock; percs slowly; slope of more than 15 percent.	Severe: depth to rock; slope of more than 7 percent.	Severe: depth to rock; too clayey; slope of more than 15 percent.	Severe: depth to rock; shrink-swell; slope of more than 15 percent.	Severe: depth to rock; shrink-swell; slope of more than 15 percent.
Vona: Vn, Vo, Vs2 [2] For Otero part of Vs2, see Otero series.	Slight	Severe: seepage	Slight	Slight	Slight
Wetmore: WE. For Mortenson part, see Mortenson series.	Severe: depth to rock; slope.	Severe: depth to rock; slope; seepage.	Severe: depth to rock; slope.	Severe: depth to rock; slope.	Severe: depth to rock; slope.
Wiley: Wk. For Kim part, see Kim series.	Moderate: percs slowly; depth to rock.	Moderate: seepage; slope is 0 to 4 percent.	Moderate: depth to rock.	Moderate: low strength; depth to rock.	Moderate: low strength.
Wormser: Wo	Severe: percs slowly; depth to rock.	Severe: depth to rock; slope is 1 to 4 percent.	Severe: depth to rock.	Severe: depth to rock; shrink-swell.	Severe: shrink-swell.

[1] Moderately rapid permeability is not a limitation for this use in this dry climate.
[2] Blowing sand is a hazard if the vegetation is removed for community development.
[3] Rapid permeability can cause a pollution hazard.
[4] Areas of Limon soil along Dry Creek, Haynes Creek, and Kraner Creek have severe limitations for land use planning because of frequent brief flooding.

excavations for pipelines, sewerlines, phone and power transmission lines, basements, open ditches, and cemeteries. Desirable soil properties are good workability, moderate resistance to sloughing, gentle slopes, absence of rock outcrops or big stones, and freedom from flooding or absence of a high water table.

Dwellings with basements and dwellings without basements are no more than three stories high and are supported by foundation footings placed in undisturbed soil. The features that affect the rating of a soil for dwellings are those that relate to capacity to support load and resist settlement under load and those that relate to ease of excavation. Soil properties that affect capacity to support load are wetness, susceptibility to flooding, density, plasticity, texture, and shrink-swell potential. Those that affect excavation are wetness, slope, depth to bedrock, and content of stones and rocks.

Sanitary landfill is a method of disposing of refuse in dug trenches. The waste is spread in thin layers,

land use planning and recreation—Continued

Sanitary landfill [1]		Streets and roads	Playgrounds	Picnic areas	Camp areas	Paths and trails
Trench	Area					
Slight	Slight	Moderate: frost action.	Slight where slope is 1 to 2 percent. Moderate where slope is 2 to 6 percent.	Slight	Slight	Slight where slope is 1 to 15 percent. Moderate where slope is 15 to 25 percent. Severe where slope is more than 25 percent.
Severe: depth to rock; slope of 1 to 25 percent.	Slight where slope is 6 to 8 percent. Moderate where slope is 8 to 15 percent. Severe where slope is more than 15 percent.	Severe: depth to rock; slope of more than 15 percent.	Severe: depth to rock; slope of more than 6 percent.	Slight where slope is 1 to 8 percent. Moderate where slope is 8 to 15 percent. Severe where slope is more than 15 percent.	Slight where slope is 1 to 8 percent. Moderate where slope is 8 to 15 percent. Severe where slope is more than 15 percent.	Slight where slope is 1 to 15 percent. Moderate where slope is 15 to 25 percent. Severe where slope is more than 25 percent.
Severe: too sandy.	Severe: seepage.	Slight	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Moderate: too sandy.
Severe: depth to rock; too clayey.	Slight where slope is 5 to 8 percent. Moderate where slope is 8 to 15 percent. Severe where slope is more than 15 percent.	Severe: depth to rock; shrink-swell; slope of more than 15 percent.	Severe: depth to rock; rock outcrops; slope of more than 6 percent.	Moderate where slope is 5 to 15 percent: rock outcrops. Severe where slope is more than 15 per cent.	Moderate where slope is 5 to 15 percent: rock outcrops. Severe where slope is more than 15 percent.	Moderate: rock outcrops; large stones.
Slight	Severe: seepage.	Moderate: low strength.	Moderate: too sandy; slope of 0 to 5 percent.	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.
Severe: depth to rock; slope.	Severe: seepage, slope.	Severe: depth to rock; slope.	Severe: slope; depth to rock.	Severe: slope.	Severe: slope.	Severe: slope.
Moderate: depth to rock.	Slight	Moderate: low strength.	Moderate: dusty; slope of 0 to 4 percent.	Moderate: dusty.	Moderate: dusty.	Moderate: dusty.
Severe: depth to rock.	Slight	Severe: shrink-swell.	Moderate: percs slowly; too clayey; slope of 1 to 4 percent.	Moderate: too clayey.	Moderate: percs slowly; too clayey.	Moderate: too clayey.

[5] The thinly bedded limestone can permit percolation and is considered a limitation.
[6] Rippable bedrock can be used if sealed.

compacted, and covered with soil. Landfill areas are subject to heavy vehicular traffic. Some soil properties that affect suitability for landfill are ease of excavation, hazard of polluting ground water, and trafficability. The best soils have moderately slow permeability, withstand heavy traffic, and are friable and easy to excavate. Unless otherwise stated, the ratings in table 7 apply only to the soil material to a depth of about 6 feet, so a limitation of *slight* or *moderate* may not be valid if trenches are to be much deeper than that. For some soils, reliable predictions can be made to a depth of 10 or 15 feet; nevertheless, every site should be investigated before it is selected.

Streets and roads have an all-weather surface expected to carry automobile traffic all year. They have a subgrade of underlying soil material; a base consisting of gravel, crushed rock, or soil material stabilized with lime or cement; and a flexible or rigid surface, commonly asphalt or concrete. These roads are graded to shed water and have ordinary provisions for drain-

age. They are built mainly from soil at hand, and most cuts and fills are less than 6 feet deep.

Soil properties that most affect design and construction of streets and roads are load-supporting capacity and stability of the subgrade and the workability and quantity of cut and fill material available. The AASHTO and Unified classifications of the soil material, and the shrink-swell potential, indicate traffic-supporting capacity. Wetness and flooding affect stability of the material. Slope, depth to hard rock, content of stones and rocks, and wetness affect ease of excavation and amount of cut and fill needed to reach an even grade.

Recreation[6]

Knowledge of soils is necessary in planning, developing, and maintaining areas used for recreation. In table 7 the degree and kind of limitations that affect the use of the soils of the Pueblo Area for playgrounds, picnic areas, camp areas, and paths and trails are shown.

Playgrounds are areas used intensively for baseball, football, badminton, and similar organized games. Soils suitable for this use need to withstand intensive foot traffic. The best soils have a nearly level surface free of coarse fragments and rock outcrops. They have good drainage and are not subject to flooding during periods of heavy use. Their surface is firm after rain but not dusty when dry. If grading and leveling are required, depth to rock is important.

Picnic areas are attractive natural or landscaped tracts that carry heavy foot traffic. Most of the vehicular traffic, however, is confined to access roads. The best soils are firm when wet but not dusty when dry, are not subject to flooding during the season of use, and do not have slopes or stones that can greatly increase the cost of leveling or of building access roads.

Camp areas are used intensively for tents and small camp trailers and the accompanying activities of outdoor living. Little preparation of the site is required other than shaping and leveling for tent and parking areas. Camp areas are subject to heavy foot traffic and limited vehicular traffic. The best soils have mild slopes, good drainage, a surface free of rocks and coarse fragments, freedom from flooding during periods of heavy use, and a surface that is firm after rain but not dusty when dry.

Paths and trails are used for local and cross-country travel by foot or on horseback. Design and layout should require little or no cutting and filling. The best soils are at least moderately well drained, are firm when wet but not dusty when dry, are flooded no more than once during the season of use, have slopes of less than 15 percent, and have few or no rocks or stones on the surface.

Formation and Classification of the Soils

This section presents the outstanding characteristics of the soils of the Pueblo Area and relates them to the factors of soil formation. Physical and chemical data are limited for these soils, thus the description of soil genesis and morphology is incomplete. The first part of the section deals with the factors of soil formation, and the second, with the classification of soils.

Factors of Soil Formation

Soil is a natural body on the surface of the earth in which plants grow. It consists of organic and mineral materials as well as air and water. Soils differ in their appearance, composition, productivity, and management requirements in different localities or even within short distances in the same locality. The factors that cause soil to differ are the physical and chemical properties of the parent material; the climate under which the soil material has accumulated and existed since accumulation; the biological factors; relief, or lay of the land; and the length of time the factors of soil formation have acted on the soil material. The relative importance of each factor in providing a soil environment differs from place to place, but generally the interaction of all the factors determines the kind of soil that forms in any given place. The effect of each soil-forming factor on the soils in the Pueblo Area is discussed in the pages that follow.

Parent material

Parent material is the weathered rock or unconsolidated material in which soils form. The hardness, grain size, and porosity of the parent material and its content of weatherable minerals greatly influence the formation of soils. There are four main kinds of parent material in the Pueblo Area: alluvium, eolian deposits, soft to hard sedimentary rocks of Cretaceous age, and Precambrian granite. These are described in the next paragraphs.

"Overlying bedrock, uncomformably, in more than half of the Pueblo Area is a cover of unconsolidated clay, silt, sand and gravel, locally more than 100 feet thick. Most of the cover was deposited by streams as they flowed across the area during hundreds of thousands of years of Quaternary times" (*7*). The stream deposits, called alluvium, vary in age from earliest Pleistocene to Holocene. Alluvium occurs in terraces well above and a considerable distance from the present streams, as well as in normally flooded present stream bottoms. For example, high-level geomorphic surfaces in the northeastern part of Pueblo County and on Baculite Mesa consist of fine-grained to coarse-grained sand and fine gravel alluvium. This alluvium may have weathered from the rock formations in nearby mountains.

Along Fountain Creek and the Arkansas River, on recent flood plains and river terraces of varying ages of deposition, is a series of alluvial deposits. The kind of soil that forms in these places depends on the texture of the alluvial material and its age.

Eolian deposits of Quaternary age include fine-grained to medium-grained sand and silt. The source of the sand is thought to be the flood plains of ancient streams. The wind blew the sand out of the alluvial basins onto uplands. Soils that form in eolian sand have little horizonation because the sand grains (quartz)

[6] By ELDIE W. MUSTARD, JR., biologist, Soil Conservation Service.

are resistant to weathering. Eolian silt or loess a few inches to several feet thick covers the plains in much of the Pueblo Area. In the foothills, loess is on east- or northeast-facing slopes. The Wiley soils were derived exclusively from loess, but the loess influence is also apparent in Manvel, Nunn, and Larkson soils.

Sedimentary rocks of Cretaceous age include shale, limestone, and sandstone. The most extensive shale formation is the Pierre Shale. Outcroppings of it parallel Fountain Creek and the Arkansas River and extend about 10 miles south of Pueblo. The formation is divided into several distinct members that vary in reaction, color, content of gypsum, concretions, and content of fossils. Of particular interest is the Tepee zone member. It is characterized by small, sharp-pointed hills shaped like inverted cones. The point of each cone has an irregular cap of light-gray or brown limestone that contains fossils. The topographic form of the buttes is the result of the resistance of their limestone caps to erosion. Razor and Midway soils formed in Pierre Shale, and Limon soils formed in alluvium that was derived from Pierre Shale. Graneros and Carlile Shale formations also occur in the survey area, generally on steep slopes. Soils that formed in shale are slowly permeable; most of the rain that falls on them runs off. Consequently, little water leaches through the profile and soil horizons form slowly.

Soft to hard limestone members of the Niobrara Formation of Cretaceous age crop out in canyons and escarpments and underlie plains in much of the Pueblo Area. The Niobrara Formation includes thick marl and calcareous shale, the Smokey Hill member; and prominent limestone, the Fort Hays member, is at its base. Soils formed slowly in limestone and marl because of the abundance of lime. Soil-forming processes proceed slowly until the lime has been leached out and the soil material changes from alkaline to neutral or acid. The Niobrara Formation is the parent material in which Penrose, Shingle, Minnequa, Manvel, and LaPorte soils formed.

Dakota Sandstone underlies the Niobrara Formation. It crops out in valleys and canyons, underlies plains in the southern part of the Pueblo Area, and lies as a hogback ridge in the western part. The Dakota Formation consists of fine-grained, thinly bedded to massive sandstone and shale. Sandstone makes up a greater part of the formation; in places there are massive sandstone cliffs more than 50 feet high. The sandstone is generally noncalcareous, although soils that formed in material derived from it can have lime layers from an accumulation of calcareous dust. Soils that formed in sandstone generally have a reddish, fine-textured B horizon. Travessilla, Kim, Vamer, Mortenson, Larkson, Pinata, and Stroupe soils formed in parent material that was partly or wholly derived from Dakota Sandstone.

Precambrian Granite crops out on steep mountain slopes and is the parent material of the gravelly, shallow Wetmore soils.

Climate

Most of the Pueblo Area is in the plains physiographic province. The plains have light rainfall, moderate to high winds and a wide range in temperature. United States Weather Bureau records at the Pueblo Airport show an average annual precipitation of 11.9 inches, an average annual temperature of 52.7° F, and an average summer (June, July, and August) temperature of 74°. An important feature of the precipitation is that 70 to 80 percent falls in the period April to September, which is the growing season. Nevertheless, evapotranspiration exceeds the precipitation. Summer precipitation is largely from thunderstorms, which sometimes are extremely heavy and yield much runoff.

Approaching the foothills and mountains in the western part from the plains in the eastern part of Pueblo County, there are a number of significant changes in the climate. The winds are less severe, temperature changes from day to day are not so great, summer temperatures are lower, and winter temperatures are higher. Precipitation increases significantly with the increasing elevation of the foothills.

An important factor in soil formation is the amount of water available for leaching during seasons when the soil is warm enough for plant growth and microbial activity. Water and temperature have a major role in the growth and activity of organic life in and on the soil, in the physical translocation of substances in the soil solutions, and in controlling the rate and direction of chemical processes. For example, soils on the plains have undergone little leaching. The depth to soluble calcium compounds in soils that have distinct horizons ranges from a few to about 20 inches and represents the average maximum depth that moisture reaches. In the mountains of the Pueblo Area, soils have lost bases and generally are acid. The surface layer has a bleached color, and the subsoil is relatively deep.

Biological factors

Biological factors are active in soil formation. In the Pueblo Area, animals, insects, bacteria, and other organisms, including man, are important biological factors (*8*), but vegetation is the most important.

The composition and density of plant growth differ between broad geographic divisions in the survey area and, less obviously, among the different soils in a landscape. The contrast between the vegetation of the plains and the woodland of the foothills and mountains is paramount.

The vegetation of the plains includes short and midtall grasses. Plant growth varies widely from year to year, depending on rainfall, and is interrupted by winter. Periods of drought are common. The summer heat hastens decomposition of annual residue, which has usually decomposed before the next season's growth. Small leaflets and stems of dry plants are easily detached and blown about by the wind. Most of the organic matter in the plains soils comes from decayed roots; the organic-matter content in the upper 8 to 10 inches of soil is 1 to 2 percent. In the foothills and mountains, where precipitation is higher and the temperature lower, plant residue is more abundant and decomposition is slower. The surface layer is darker colored under grass in these areas than on the plains. Also, it has 2 to 3 percent more organic matter.

Under forest vegetation the forest litter, including fungi, produces acids and other substances of great

solvent activity. Forest organic materials, combined with the higher precipitation of the foothills and mountains and the low-calcium parent material, greatly intensify leaching processes in these areas.

Small differences in vegetation can be seen on well-drained soil in any given landscape. Where such differences occur, it may be difficult to determine the effect of vegetation on soil formation. Such differences in the vegetation are not necessarily the result of differences in soil characteristics, but can reflect other environmental influences.

The activity of man has influenced the formation of Rocky Ford soils and other irrigated soils. By providing irrigation water, man has changed the soil climate, leading to an increase in the number of earthworms, the amount of microbial activity, and the amount of plant residue. Intensive tillage, fertilizers, and the silt-laden irrigation water have made Rocky Ford soils different from nonirrigated soils. The surface layer of Rocky Ford soils is 10 to 15 inches thick, and it is darker colored and more fertile than that of nonirrigated soils.

Relief

Relief refers to differences in elevation and inequalities of the land surface, considered collectively. Relief influences soil formation primarily through its effect on drainage, runoff, and erosion and secondarily through variations in exposure to the sun and wind and in air drainage.

The relief of the plains part of the Pueblo Area is gently undulating; some steep escarpments are on terrace edges or below outcrops of limestone or sandstone. In the dry climate of the plains, the influence of relief on soil formation is mostly through its effect on erosion. In fine-textured soils, such as those of the Midway, Razor, and Limon series, the devastating effect of erosion on profile development can be seen in many places. Distinct differences in soil characteristics in places are associated with relatively minor differences in slope and landforms within a given landscape. Relief influences soil formation by virtue of its effect on runoff. Where the total amount of rainfall is small, slight differences in the supply of moisture can account for relatively great differences in vegetation production and in soil morphology. Soils in concave areas, where runoff tends to concentrate, show more evidence of horizonation than soils on the surrounding landscape. For example, Baca soils, which are in slightly concave areas, have more horizon development than Manvel soils.

On river and creek bottoms, where the relief is nearly flat, there is a gradient that tends to produce lateral movement of ground water from the stream to the surface of the soils. Nearly all of the poorly drained to moderately well drained soils are on flood plains. Soluble salts tend to accumulate in the surface of these soils.

In the foothills and mountains, relief influences soil formation through variation in aspect. North-facing slopes have a more moist, cooler climate than south-facing slopes. Mortenson soils in the Pueblo Area form only on north-facing slopes in the foothills. Wetmore and Pinata soils are mostly on north-facing slopes. Slopes are steeper and differences in elevation greater in the foothills and mountains than on the plains, and there is more potential for runoff. However, more and taller vegetation and rock fragments tend to offset relief and reduce runoff.

Time

The time required for soil horizons to differentiate in parent material may range from several decades to tens of thousands or even hundreds of thousands of years, depending on the nature of the parent material, the climate, and the relief. In the Pueblo Area the age of the soil is usually related to the age of the landform. The most recent or youngest landform occurs on flood plains of streams. The soils that formed in alluvium on flood plains have an A horizon but do not have a Ca horizon or have only a faint one, as in the Glenberg and Haverson soils. The Cascajo soils on high stream terraces formed in older gravelly alluvium. They have distinct A and Ca horizons. In loamy and fine-textured parent material the degree of development of the B horizon can be related to the age of the landform in characteristics of structure, color, and clay content. The B horizon of the oldest soils is usually redder and has stronger structure and distinct, angular blocky structure.

The age of soils can also be related to stages of development. In the foothills and mountains in the western part of the survey area, the factors of climate, parent material, and living organisms reinforce each other so that soil horizons differentiate more rapidly than on the plains. The landform may or may not be older than those on the plains, but because of the more rapid soil-forming processes the soils are in a more advanced stage of development.

Youthful soils resemble the parent material in which they form. Mature soils have distinct horizons that lie one above the other and are parallel to the earth's surface.

Classification of the Soils

Soils are classified so that we can more easily remember their significant characteristics. Classification enables us to assemble knowledge about the soils, to see their relationship to one another and to the whole environment, and to develop principles that help us to understand their behavior and their response to manipulation. First through classification, and then through use of soil maps, we can apply our knowledge of soils to specific fields and other tracts of land.

The narrow categories of classification, such as those used in detailed soil surveys, allow us to organize and apply knowledge about soils in managing farms, fields, and woodlands; in developing rural areas; in engineering work; and in many other ways. Soils are placed in broad classes to facilitate study and comparison in large areas, such as countries and continents.

The system of soil classification currently used was adopted by the National Cooperative Soil Survey in 1965. Because this system is under continual study, readers interested in developments of the current system should search the latest literature available (*10*).

The current system of classification has six categories. Beginning with the broadest, these categories are the order, the suborder, the great group, the subgroup, the family, and the series. In this system the criteria used as a basis for classification are soil properties that are observable and measurable. The properties are chosen, however, so that the soils of similar genesis, or mode of origin, are grouped. In table 8, the soil series of the Pueblo Area are placed in categories of the current system. Classes of the current system are briefly defined in the following paragraphs.

ORDER. Ten soil orders are recognized. The properties used to differentiate among soil orders are those that tend to give broad climatic groupings of soils. The two exceptions to this are the Entisols and Histosols, which occur in many different climates. Each order is named with a word of three or four syllables, ending in *sol* (Arid-i-sol).

SUBORDER. Each order is divided into suborders, based mainly on those soil characteristics that seem to produce classes that have the greatest genetic similarity. The suborders narrow the broad climatic range permitted in the orders. The soil properties used to separate suborders are mainly those that reflect either the presence or absence of waterlogging, or soil differences that result from the climate or vegetation. The names of suborders have two syllables. The last syllable indicates the order. An example is *Argid* (*Arg*, meaning illuvial clay, and *id*, from Aridisol).

GREAT GROUP. Soil suborders are separated into great groups on the basis of uniformity in the kinds and sequence of major soil horizons and features. The

TABLE 8.—*Classification of the soils*

Soil series	Family	Subgroup	Order
Absted	Fine, montmorillonitic, mesic	Haplustollic Natrargids	Aridisols.
Adena	Fine-loamy, mixed, mesic	Ustollic Paleargids	Aridisols.
Apishapa	Fine, montmorillonitic (calcareous), mesic	Vertic Haplaquepts	Inceptisols.
Arvada	Fine, montmorillonitic, mesic	Ustollic Natrargids	Aridisols.
Baca	Fine, montmorillonitic, mesic	Ustollic Haplargids	Aridisols.
Bankard	Sandy, mixed, mesic	Ustic Torrifluvents	Entisols.
Bloom	Fine-silty, mixed (calcareous), mesic	Typic Haplaquepts	Inceptisols.
Cascajo	Sandy-skeletal, mixed, mesic	Ustollic Calciorthids	Aridisols.
Denver	Fine, montmorillonitic, mesic	Torrertic Argiustolls	Mollisols.
Dwyer	Mixed, mesic	Ustic Torripsamments	Entisols.
Gilcrest	Coarse-loamy, mixed, mesic	Ustollic Haplargids	Aridisols.
Glenberg	Coarse-loamy, mixed (calcareous), mesic	Ustic Torrifluvents	Entisols.
Haverson	Fine-loamy, mixed (calcareous), mesic	Ustic Torrifluvents	Entisols.
Heldt	Fine, montmorillonitic, mesic	Ustertic Camborthids	Aridisols.
Holderness	Fine, montmorillonitic	Aridic Argiborolls	Mollisols.
Keyner	Fine-loamy, mixed, mesic	Haplustollic Natrargids	Aridisols.
Kim	Fine-loamy, mixed (calcareous), mesic	Ustic Torriorthents	Entisols.
LaPorte	Loamy, mixed, mesic	Lithic Haplustolls	Mollisols.
Larkson	Fine, montmorillonitic	Typic Eutroboralfs	Alfisols.
Las Animas	Coarse-loamy, mixed (calcareous), mesic	Typic Fluvaquents	Entisols.
Limon	Fine, montmorillonitic (calcareous), mesic	Ustertic Torriorthents	Entisols.
Manvel	Fine-silty, mixed (calcareous), mesic	Ustic Torriorthents	Entisols.
Manzanola	Fine, montmorillonitic, mesic	Ustollic Haplargids	Aridisols.
Midway	Clayey, montmorillonitic (calcareous), mesic, shallow.	Ustic Torriorthents	Entisols.
Minnequa	Fine-silty, mixed (calcareous), mesic	Ustic Torriorthents	Entisols.
Mortenson	Clayey-skeletal, montmorillonitic	Typic Paleboralfs	Alfisols.
Nederland	Loamy-skeletal, mixed, mesic	Aridic Argiustolls	Mollisols.
Neville	Fine-loamy, mixed (calcareous), mesic	Ustic Torriorthents	Entisols.
Nunn	Fine, montmorillonitic, mesic	Aridic Argiustolls	Mollisols.
Olney	Fine-loamy, mixed, mesic	Ustollic Haplargids	Aridisols.
Otero	Coarse-loamy, mixed (calcareous), mesic	Ustic Torriorthents	Entisols.
Penrose	Loamy, mixed (calcareous), mesic	Lithic Ustic Torriorthents	Entisols.
Pinata	Clayey-skeletal, mixed	Typic Eutroboralfs	Alfisols.
Razor	Fine, montmorillonitic, mesic	Ustollic Camborthids	Aridisols.
Rocky Ford	Fine-silty, mixed (calcareous), mesic	Ustic Torriorthents	Entisols.
Schamber	Sandy-skeletal, mixed, mesic	Ustic Torriorthents	Entisols.
Shingle	Loamy, mixed (calcareous), mesic, shallow	Ustic Torriorthents	Entisols.
Stoneham	Fine-loamy, mixed, mesic	Ustollic Haplargids	Aridisols.
Stroupe	Clayey-skeletal, mixed, mesic	Aridic Argiustolls	Mollisols.
Table Mountain [1]	Fine-loamy, mixed, mesic	Pachic Haplustolls	Mollisols.
Travessilla	Loamy, mixed (calcareous), mesic	Lithic Ustic Torriorthents	Entisols.
Valent	Mixed, mesic	Ustic Torripsamments	Entisols.
Vamer	Clayey, mixed	Lithic Eutroboralfs	Alfisols.
Vona	Coarse-loamy, mixed, mesic	Ustollic Haplargids	Aridisols.
Wetmore	Loamy-skeletal, mixed	Lithic Eutroboralfs	Alfisols.
Wiley	Fine-silty, mixed, mesic	Ustollic Haplargids	Aridisols.
Wormser	Fine, montmorillonitic, mesic	Aridic Argiustolls	Mollisols.

[1] These soils are taxadjuncts to the Table Mountain series because they are calcareous to the surface and are grayish brown to a depth of 50 inches or more; otherwise, they are similar in morphology, use, behavior, and management.

horizons used to make separations are those in which clay, iron, or humus has accumulated; those that have pans that interfere with growth of roots, movement of water, or both; and thick, dark-colored surface horizons. The features used are the self-mulching properties of clay, soil temperature, major differences in chemical composition (mainly calcium, magnesium, sodium, and potassium), dark-red and dark-brown colors associated with basic rocks, and the like. The names of great groups have three or four syllables and are made by adding a prefix to the name of the suborder. An example is *Natrargid* (*Natr*, meaning presence of significant amounts of exchangeable sodium or of sodium and magnesium, and *argid*, the suborder of Aridisols that have an illuvial clay horizon).

SUBGROUP. Great groups are divided into subgroups, one that represents the central (typic) segment of the group and others, called intergrades, that have properties of the group and also one or more properties of another great group, suborder, or order. Subgroups may also be made in those instances where soil properties intergrade outside the range of any other great group, suborder, or order. The names of subgroups are derived by placing one or more adjectives in front of the name of the great group. An example is *Ustollic Natrargids* (*Ustollic*, meaning intergrading to the suborder of Ustolls in the order of Mollisols).

FAMILY. Soil families are established within a subgroup mainly on the basis of properties important to the growth of plants or on the behavior of soils when used for engineering. Among the properties considered are texture, mineralogy, reaction, soil temperature, permeability, thickness of horizons, and consistence. A family name consists of a series of adjectives preceding the subgroup name. The adjectives are the class names for texture, mineralogy, and so on, that are used as family differentiae (see table 8). An example is the fine, montmorillonitic, mesic family of Ustollic Natrargids.

General Nature of the Area

The Pueblo Area is included in parts of two natural physiographic areas (*12*). About 95 percent is gently rolling plains of the upper Arkansas River Valley. Elevation of this physiographic area ranges from 4,400 to 5,800 feet, increasing gradually from east to west. These undulating to rolling shale plains are mantled with loess or windblown sand, alluvium, or outwash in many places. Wide bands of steep slopes border the Arkansas River and larger tributaries. Local relief is mostly less than 50 feet but is as much as 200 feet in places.

About 5 percent of the survey area is foothills of the southern Rocky Mountains. Elevation ranges from 5,800 to 8,000 feet. The physiography consists of rugged hills and low mountains in a narrow band along the eastern slopes of the Rocky Mountains. The hills are much dissected, being crossed in many places by small drainageways that flow eastward. Local relief is several hundred feet in many places.

Greenhorn Peak, at an elevation of 10,334 feet, is in the extreme southwestern part of Pueblo County and within the San Isabel National Forest. About 32,415 acres of this national forest is in Pueblo County but was not included in the area of this soil survey.

Drainage is provided by the Arkansas River and its tributaries. The Arkansas River begins near the Continental Divide in the mountains to the west and flows eastward near the center of the survey area. Other perennial streams in Pueblo County that empty into the Arkansas River are Fountain Creek, the St. Charles River, Greenhorn Creek, and the Huerfano River. The Apishapa River flows across the southeast corner of Pueblo County. Except for the Arkansas River, these drainageways become a mere trickle during periods of drought. Numerous intermittent streams, in a generally north-south orientation, empty into the Arkansas River.

Virtually all of the mining operations in the Pueblo Area are concerned with the extraction of sand, gravel, and clay. Numerous gravel pits along the Arkansas River and in the western part of Pueblo County provide gravel for road surfacing and ready-mix concrete plants. There are seven clay mines from which raw material is obtained for sewer pipe and brick. There is one mine of a particularly pure form of sand from deep in the Dakota Formation that is used in steel processing at Pueblo. There is about 18,600 acres of commercial timber in the western part of the survey area.

The Pueblo Area is underlain by beds of limestone, shale, and sandstone. The limestone and shale contain no water. Superficial deposits above the limestone yield small quantities of water in places, which are sufficient to water livestock. In the northeastern part of Pueblo County, good-quality stock water can usually be obtained within a depth of 130 feet. The best source of water is the Dakota Formation, but water is not obtained in this formation every place wells are dug. It does yield water in most places in sufficient quantity and quality for domestic and livestock uses.

The extreme western part of the survey area consists of rough, timber-covered, mountainous terrain. The timber is of two types, ponderosa pine and mixed conifer, which consists mostly of Douglas-fir and white fir. Most of the Pueblo Area has short plains grasses, mainly blue gramma and galleta. Some mid and tall grasses grow in the sandhills in the northeast, along with sand sagebrush. Between the mountains and the plains is a transition zone of pinyon pine and juniper, oakbrush, mountainmahogany, and numerous species of grass.

The Pueblo Area is at the junction of Federal Interstate 25, U.S. 50, and State Highway 96. The survey area also is served by four major railroads, one regional airline, and two transcontinental bus companies.

Climate[7]

The climate in the Pueblo Area is semi-arid. The average annual precipitation is 11.9 inches. At least 75 percent of the possible sunshine is received in all months. There is little or no tornado activity of consequence. The discussion of the climate in the following paragraphs is based on data from the weather

[7] Prepared by the National Climatic Center in Asheville, N.C.

station at the Pueblo City Airport, unless stated otherwise.

Warm, moist air from the south moves into Pueblo County most frequently in spring, bringing the heaviest rainfall of the year. There are frequent showers and thunderstorms until well into summer. In spring the average daily maximum temperature ranges from the mid 50's to the mid 70's. The average daily minimum temperature ranges from the mid 20's to the high 40's. Heavy accumulations of snow at the higher elevations in winter followed by rapid warming in spring may cause extensive flooding. Normally, widespread flooding does not occur in spring.

In summer the maximum temperature reaches 90° F or more about 1 day out of 2, but because of the low relative humidity the heat is not oppressive. Summer nights are invariably cool because of the elevation. Mountain breezes usually prevail from just after sunset to about noon the next day. The average daily maximum temperature ranges from the mid 80's to the low 90's. The average daily minimum temperature ranges from the mid 50's to the low 60's. With an inflow of air from the southwest, the survey area receives its hottest weather of the year. These periods of higher temperatures are usually of short duration. In summer, noon relative humidity is about 35 percent. The prevailing wind is from the southeast at about 9 miles per hour. Most of the precipitation in the survey area is received during the growing season. Table 9 shows the average precipitation by months of the year. Thunderstorms occur on an average of about 35 days during summer.

In fall, cold air from the north begins to move into the survey area with increasing frequency and often results in a sudden drop in temperature. The average daily maximum temperature ranges from the mid 50's to the low 80's. The average daily minimum temperature ranges from the high 20's to the low 50's. Little precipitation is received during fall.

Winter is usually rather mild because of the abundance of sunshine and the protection afforded by the nearby mountains. Cold air from the north does invade the survey area, and blizzards occasionally occur in Pueblo County. These cold spells usually last 3 to 5 days, when they are often ended by "chinook" winds. Chinook (or Foehn) is the name given to the warm winds that blow down the eastern slopes of the Rocky Mountains. The rise in temperature is the result of three factors acting together. The replacement of a cold air mass by the advection of warmer air, dynamic heating by subsidence, and the destruction of the normal night ground inversion. These "chinook" winds may cause sudden temperature rises of more than 40° F. As a rule, less precipitation is received in winter than in fall. Strong winds occur frequently in winter and spring. After an unusually dry winter, duststorms may occur, particularly in dryfarming areas. The prevailing wind is from the west at about 8 miles per hour. The relative humidity at noon is about 45 percent.

The average growing season for Pueblo County is 167 days. The last freeze in spring generally occurs on April 29 and the first in the fall on October 13. Table 10 shows the probabilities of freezing temperatures.

TABLE 9.—*Temperature and precipitation data*

[All data are from Pueblo]

Month	Temperature				Precipitation				
			Two years in 10 will have at least 4 days with [2]—			One year in 10 will have[1]—			
	Average daily maximum [1]	Average daily minimum [1]	Maximum temperature equal to or higher than—	Minimum temperature equal to or lower than—	Average [1]	Less than—	More than—	Days with snow cover [2]	Average depth of snow on days with snow cover [2]
	°F	°F	°F	°F	In	In	In	Number	In
January	45.5	14.7	65	−6	0.32	0.05	0.74	8	3
February	49.8	19.6	67	2	.32	.05	.64	4	2
March	54.9	25.0	75	8	.68	.16	1.11	4	3
April	66.4	36.9	82	23	1.29	.08	2.47	1	2
May	75.5	46.6	90	36	1.65	.39	3.18	----	----
June	85.8	55.6	99	47	1.36	.29	2.88	----	----
July	91.1	61.6	101	55	1.87	.73	3.57	----	----
August	88.8	60.1	98	52	1.96	.51	3.50	----	----
September	81.5	50.8	94	39	.79	.15	1.39	----	----
October	70.7	38.2	86	27	.96	.06	2.10	----	----
November	56.5	25.1	73	12	.42	.02	.77	2	2
December	48.2	17.7	67	1	.29	.01	.62	6	3
Year	67.9	37.7	[3] 105	[4] −28	11.91	7.51	15.57	25	3

[1] Based on the period 1941–70.
[2] Based on the period 1955–73.
[3] Average annual highest temperature.
[4] Average annual lowest temperature.

TABLE 10.—*Probabilities of low temperatures in spring and fall*

[All data from Pueblo, Colorado, for the period 1955–73]

Probability	Dates for given probability and temperature				
	16° F or lower	20° F or lower	24° F or lower	28° F or lower	32° F or lower
Spring:					
1 year in 10 later than	April 7	April 12	April 16	April 30	May 13
2 years in 10 later than	April 1	April 6	April 12	April 25	May 8
5 years in 10 later than	March 22	March 27	April 4	April 18	April 29
Fall:					
1 year in 10 earlier than	November 5	October 19	October 16	October 11	September 26
2 years in 10 earlier than	November 10	October 25	October 20	October 15	October 2
5 years in 10 earlier than	November 19	November 6	October 30	October 22	October 13

Near the mountains, winds are more moderate and day-to-day temperature changes are not so great as in areas away from the mountains. Temperatures in the foothills are cooler in summer and warmer in winter. Above an elevation of 7,000 feet, the average July temperature is about 60° F and the average January temperature is about 20°. The growing season is considerably shorter at this elevation. Also, precipitation generally increases rapidly with increasing elevation.

Trends in Soil Use

Farm development in the Pueblo Area began in 1859, a spinoff of the gold rush to the Rockies. The arrival of the railroad in the 1870's brought an influx of settlers and concurrent development of farming and industry. The early farms were along streams, where water could be diverted for irrigation. Later, the Homestead Act and high crop prices during war years stimulated attempts at dryland farming. The cyclical nature of drought and of crop prices caused many farm failures, particularly on land not suited to farming. Many families had to leave their land. Because of abandonment of land and tax delinquency, many ranches increased in size. About 72 percent of the acreage of the Pueblo Area is range.

U.S. Census of Agriculture statistics show a decrease in the number of farms and ranches in Pueblo County from 884 in 1958 to 615 in 1969. The average size of the farms and ranches increased from 1,637 acres in 1958 to 1,843 acres in 1969. The acres of irrigated land decreased from 43,601 in 1958 to 35,338 in 1969.

The farming trend of the survey area in the past decade has been toward increasing production of cattle. Increasing production costs have caused farmers to raise crops that require a minimum of input and are useful to livestock. According to 1973 statistics of the Colorado Department of Agriculture, the planted acres in the survey area have increased from 7,020 acres of corn for grain in 1961 to 13,000 acres in 1971 and from 10,030 acres of sorghum for grain in 1961 to 15,000 acres in 1971. During the same period, the planted acres have decreased from 27,750 acres of dry beans in 1961 to 8,900 acres in 1961; 17,000 acres of hay (alfalfa, including mixtures) in 1961 to 11,500 acres in 1971; 13,160 acres of winter wheat in 1961 to 10,000 in 1971; 4,480 acres of barley in 1961 to 1,550 acres in 1971; 4,059 acres of sugar beets in 1961 to 380 in 1971; and 3,370 acres of oats in 1961 to 2,400 acres in 1971. The value of all crop production in Pueblo County in 1971 was $4,434,400.

The estimated number of cattle and calves on farms and ranches increased from 54,330 in 1961 to 64,000 in 1971. Hogs and sheep declined from an estimated 8,600 in 1961 to 5,600 in 1971.

Industry in the survey area includes a large steel mill. Many of the products of the area, including fertilizer, are used by ranchers and farmers of the area. About 152 wholesalers, manufacturers, and businesses in the city of Pueblo serve the Pueblo Area. Many of them process farm products or supply farm needs. The Colorado State Fair has been held annually in Pueblo for more than 100 years.

Federal government installations include the Pueblo Ordinance Depot, Department of Transportation High Speed Ground Test Center, and part of the Ft. Carson military reservation. These three installations occupy 119,650 acres of former grazing land.

The city of Pueblo is within an hour's driving time of some of Colorado's most beautiful mountain scenery. Residents of the Pueblo Area enjoy lower elevation living, yet can fish, hunt, ski, camp, and picnic in the higher mountains. Completion of the Pueblo dam and reservoir will provide a 30,000-acre permanent pool planned for reaction use. The main purpose of the reservoir is to provide flood protection and storage of water diverted from the western slope. The water will be used to supplement irrigation and domestic supplies of communities along the Arkansas River below Pueblo, as well as the city of Pueblo.

The mild, dry climate of the survey area and the recreational opportunities attract many people who seek a quality environment in which to live. The population of Pueblo County grew from 118,707 in 1960 to 120,241 in 1972. Of the latter, 102,525 are in the city of Pueblo. Numerous land owners of the survey area have found it profitable to subdivide their property for building sites. Two major developments are actually satellite cities of Pueblo. The survey area is within what is called the "front range strip" in referring to regional population growth.

The USDA Pueblo County Conservation Needs Inventory shows a decrease in the acres of pasture and

range from 1,116,333 in 1958 to 1,092,208 in 1971. During the same period, the acreage of urban and built-up land increased from 28,313 acres to 70,618 acres.

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Glossary

Alkali soil. Generally, a highly alkaline soil. Specifically, an alkali soil has so high a degree of alkalinity (pH 8.5 or higher) or so high a percentage of exchangeable sodium (15 percent or more of the total exchangeable bases), or both, that the growth of most crop plants is low from this cause.

Area reclaim. Borrow areas are difficult to reclaim, and revegetation and erosion control on these areas are extremely difficult.

Available water capacity (also termed available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil.

Channery soil. A soil that contains thin, flat fragments of sandstone, limestone, or schist, as much as 6 inches in length along the longer axis. A single piece is called a fragment.

Chiseling. Tillage of soil with an implement having one or more soil penetrating points that loosen the subsoil and bring *clods* to the surface. A form of emerging tillage to control soil blowing.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of clay on the surface of a soil aggregate. Synonyms: clay coat, clay skin.

Complex slope. Short and irregular slopes. Planning and construction of terraces, diversions, and other water-control measures are difficult.

Compressible. The soil is relatively soft and decreases excessively in volume when a load is applied.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material, and tends to stretch somewhat and pull apart, rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard and brittle; little affected by moistening.

Cutbanks cave. Walls of cuts are not stable. The soil sloughs easily.

Depth to rock. Bedrock is so near the surface that it affects specified use of the soil.

Diversion, or diversion terrace. A ridge of earth, generally a terrace, that is built to divert runoff from its natural course and, thus, to protect areas downslope from the effects of such runoff.

Drainage class (natural). Refers to the conditions of frequency and duration of periods of saturation or partial saturation that existed during the development of the soil, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven different classes of natural soil drainage are recognized.

Excessively drained soils are commonly very porous and rapidly permeable and have a low available water capacity.

Somewhat excessively drained soils are also very permeable and are free from mottling throughout their profile.

Well-drained soils are nearly free from mottling and are commonly of intermediate texture.

Moderately well drained soils commonly have a slowly permeable layer in or immediately beneath the solum. They have uniform color in the A and upper B horizons and mottling in the lower B and the C horizons.

Somewhat poorly drained soils are wet for significant periods but not all the time, and some soils commonly have mottling at a depth below 6 to 16 inches.

Poorly drained soils are wet for long periods and are light gray and generally mottled from the surface downward, although mottling may be present or nearly so in some soils.

Very poorly drained soils are wet nearly all the time. They have a dark-gray or black surface layer and are gray or light gray, with or without mottling, in the deeper parts of the profile.

Eolian soil material. Earthy parent material accumulated through wind action; commonly refers to sandy material in dunes or to loess in blankets on the surface.

Excess alkali. Exchangeable sodium imparts poor physical properties that restrict the growth of plants.

Excess fines. The soil contains too much silt and clay for use as gravel or sand in construction.

Excess lime. The amount of carbonates in the soil is so high that it restricts the growth of some plants.

Excess salt. The amount of soluble salt in the soil is so high that it restricts the growth of most plants.

Fast intake. Water infiltrates rapidly into the soil.

Favorable. Features of the soil are favorable for the intended use.

Frost action. Freezing and thawing may damage structures.

Horizon, soil. A layer of soil, approximately parallel to the surface, that has distinct characteristics produced by soil-forming processes. These are the major horizons:

O horizon.—The layer of organic matter on the surface of a mineral soil. This layer consists of decaying plant residues.

A horizon.—The mineral horizon at the surface or just below an O horizon. This horizon is the one in which living organisms are most active and therefore is marked by the accumulation of humus. The horizon may have lost one or more of soluble salts, clay, and sesquioxides (iron and aluminum oxides).

B horizon.—The mineral horizon below an A horizon. The B horizon is in part a layer of change from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics caused (1) by accumulation of clay, sesquioxides, humus, or some combination of these; (2) by prismatic or blocky structure; (3) by redder or stronger colors than the A horizon; or (4) by some combination of these. Combined A and B horizons are usually called the solum, or true soil. If a soil lacks a B horizon, the A horizon alone is the solum.

C horizon.—The weathered rock material immediately beneath the solum. In most soils this material is presumed to be like that from which the overlying horizons were formed. If the material is known to be different from that in the solum, a Roman numeral precedes the letter C.

R layer.—Consolidated rock beneath the soil. The rock usually underlies a C horizon but may be immediately beneath an A or B horizon.

Large stones. Rock fragments 10 inches or more across affect the specified use.

Loess. Fine-grained material, dominantly of silt-sized particles, that has been deposited by wind.

Low strength. The soil has inadequate strength to support loads.

Mottling, soil. Irregularly marked with spots of different colors that vary in number and size. Mottling in soils usually indicates poor aeration and lack of drainage. Descriptive terms are as follows: abundance—*few, common,* and *many;* size—*fine, medium,* and *coarse;* and contrast—*faint, distinct,* and *prominent.* The size measurements are these: *fine,* less than 5 millimeters (about 0.2 inch) in diameter along the greatest dimension; *medium,* ranging from 5 millimeters to 15 millimeters (about 0.2 to 0.6 inch) in diameter along the greatest dimension; and *coarse,* more than 15 millimeters (about 0.6 inch) in diameter along the greatest dimension.

Parent material. Disintegrated and partly weathered rock from which soil has formed.

Ped. An individual natural soil aggregate, such as a crumb, a prism, or a block, in contrast to a clod.

Percs slowly. Water moves through the soil slowly, affecting the specified use.

Piping. The soil is susceptible to the formation of tunnels or pipelike cavities by moving water.

Poor outlets. Surface or subsurface drainage outlets are difficult or expensive to install.

Range condition. The state of health or productivity of both soil and forage in a given range, in terms of what productivity could or should be under normal climate and the best practical management. Condition classes generally recognized are—*excellent, good, fair,* and *poor.* The classification is based on the percentage of original, or climax, vegetation on the site, as compared to what ought to grow on it if management were good.

Reaction, soil. The degree of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is precisely neutral in reaction because it is neither acid nor alkaline. An acid, or "sour," soil is one that gives an acid reaction; an alkaline soil is one that is alkaline in reaction. In words, the degrees of acidity or alkalinity are expressed thus:

	pH		pH
Extremely acid	Below 4.5	Neutral	6.6 to 7.3
Very strongly acid	4.5 to 5.0	Mildly alkaline	7.4 to 7.8
Strongly acid	5.1 to 5.5	Moderately alkaline	7.9 to 8.4
Medium acid	5.6 to 6.0	Strongly alkaline	8.5 to 9.0
Slightly acid	6.1 to 6.5	Very strongly alkaline	9.1 and higher

Relief. The elevation or inequalities of a land surface, considered collectively.

Rooting depth. A layer that greatly restricts the downward rooting of plants occurs at a shallow depth.

Saline soil. A soil that contains soluble salts in amounts that impair growth of plants but that does not contain excess exchangeable sodium.

Sand. Individual rock or mineral fragments in a soil that range in diameter from 0.05 to 2.0 millimeters. Most sand grains consist of quartz, but they may be of any mineral composition. The textural class name of any soil that contains 85 percent or more sand and not more than 10 percent clay.

Seepage. Water moves through the soil so quickly that it affects the specified use.

Shrink-swell. The soil expands on wetting and shrinks on drying, which may cause damage to roads, dams, building foundations, or other structures.

Silt. Individual mineral particles in a soil that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). Soil of the silt textural class is 80 percent or more silt and less than 12 percent clay.

Slick spots. Small areas in a field that are slick when wet because they contain excess exchangeable sodium, or alkali.

Slow intake. Water infiltrates slowly into the soil.

Small stones. Rock fragments that are less than 10 inches across may affect the specified use.

Soil. A natural, three-dimensional body on the earth's surface that supports plants and that has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Structure, soil. The arrangement of primary soil particles into compound particles or clusters that are separated from adjoining aggregates and have properties unlike those of an equal mass of unaggregated primary soil particles. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular. Structureless* soils are either *single grained* (each grain by itself, as in dune sand) or *massive* (the particles adhering together without any regular cleavage, as in many claypans and hardpans).

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Subsoiling. Tillage of a soil below normal depth ordinarily to shatter a hardpan or claypan.

Substratum. Technically, the part of the soil below the solum.

Surface soil. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, about 5 to 8 inches in thickness. The plowed layer.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that it may soak into the soil or flow slowly to a prepared outlet without harm. Terraces in fields are generally built so they can be farmed. Terraces intended mainly for drainage have a deep channel that is maintained in permanent sod.

Terrace (geological). An old alluvial plain, ordinarily flat or undulating, bordering a river, lake, or the sea. Stream terraces are frequently called second bottoms, as contrasted to flood plains, and are seldom subject to overflow. Marine terraces were deposited by the sea and are generally wide.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay.* The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Thin layer. Suitable soil material is not thick enough for use as borrow material or topsoil.

Tilth, soil. The condition of the soil in relation to the growth of plants, especially soil structure. Good tilth refers to the friable state and is associated with high noncapillary porosity and stable, granular structure. A soil in poor tilth is nonfriable, hard, nonaggregated, and difficult to till.

Topsoil. A presumed fertile soil or soil material, or one that responds to fertilization, ordinarily rich in organic matter, used to topdress roadbanks, lawns, and gardens.

Water table. The highest part of the soil or underlying rock material that is wholly saturated with water. In some places an upper, or perched, water table may be separated from a lower one by a dry zone.

GUIDE TO MAPPING UNITS

For a full description of a mapping unit, read the description of the mapping unit and that of the soil series to which the mapping unit belongs. General information about management is given in the sections "Capability grouping" and "Range." Woodland suitability groups are discussed on pages 51 and 52.

Map symbol	Mapping unit	Page	Capability unit Irrigated Symbol	Irrigated Page	Nonirrigated Symbol	Nonirrigated Page	Range site Name	Range site Page
Ab	Absted clay loam	8	------	--	VIe-2	43	Alkaline Plains	47
Am	Adena-Manvel loams	9	------	--	VIe-1	43	Loamy Plains	48
Ap	Apishapa silty clay	9	IIIw-1	41	VIw-1	44	Salt Meadow	49
AR	Arvada-Keyner association	10	------	--	VIe-2	43	----------	--
	Arvada part	--	------	--	------	--	Salt Flats	49
	Keyner part	--	------	--	------	--	Alkaline Plains	47
Bc	Baca silty clay loam	11	I	40	IVe-1	42	Loamy Plains	48
Bk	Bankard sand	12	------	--	VIw-2	44	1/	--
Bm	Bloom silt loam	12	IIIw-1	41	VIw-1	44	Salt Meadow	49
CaE	Cascajo very gravelly sandy loam, 5 to 25 percent slopes	13	------	--	VIIs-2	44	Gravel Breaks	48
CsE	Cascajo-Shale outcrop complex, 5 to 30 percent slopes	13	------	--	VIIs-2	44	----------	--
	Cascajo part	--	------	--	------	--	Gravel Breaks	48
	Shale outcrop part	--	------	--	------	--	----------	--
DeD	Denver clay loam, 3 to 9 percent slopes	14	IIIe-2	41	VIe-4	43	Clayey Foothills	47
Dw	Dwyer loamy sand	14	------	--	VIe-3	43	Deep Sand	47
EBF	Eutroboralfs, steep	14	------	--	VIIs-4	45	1/	--
GcA	Gilcrest sandy loam, 0 to 2 percent slopes	15	------	--	VIe-3	43	Sandy Plains	50
GeD	Gilcrest gravelly sandy loam, 3 to 9 percent slopes	15	------	--	VIe-3	43	Sandy Plains	50
GfC	Gilcrest complex, 3 to 6 percent slopes	15	------	--	VIe-3	43	Sandy Plains	50
Gh	Glenberg-Haverson fine sandy loams	16	IIe-1	40	VIe-1	43	Sandy Bottomland	50
Ha	Haverson silt loam	16	IIw-1	40	VIw-2	44	Saline Overflow	49
He	Heldt silty clay loam, 2 to 6 percent slopes	17	------	--	VIe-2	43	Alkaline Plains	47
Ho	Holderness silt loam, 3 to 9 percent slopes	17	------	--	IVe-3	43	Loamy Park	48
Ke	Keyner loamy sand, wet	18	------	--	VIw-1	44	Salt Meadow	49
Km	Kim fine sandy loam	18	I	40	VIe-1	43	Loamy Plains	48
LaE	LaPorte channery loam, 3 to 25 percent slopes	19	------	--	VIIs-3	45	Shallow Foothills	51
LbD	Larkson loam, 6 to 12 percent slopes	20	------	--	IVe-3	43	----------	--
LcE	Larkson stony loam, 5 to 20 percent slopes	20	------	--	VIe-5	44	----------	--
Lm	Las Animas fine sandy loam	20	IIIw-2	41	VIw-1	44	Salt Meadow	49
LnA	Limon silty clay loam, 0 to 2 percent slopes	21	IIe-1	40	VIe-2	43	Salt Flats	49
LnB	Limon silty clay loam, 2 to 5 percent slopes	21	IIIe-2	41	VIe-2	43	Salt Flats	49
LoA	Limon silty clay, 0 to 2 percent slopes	21	IIIs-1	42	VIe-2	43	Salt Flats	49
LvB	Limon silty clay, 0 to 5 percent slopes, gullied	21	------	--	VIIe-1	44	1/	--
MaA	Manvel silt loam, 0 to 1 percent slopes	22	I	40	VIe-1	43	Loamy Plains	48
MaB	Manvel silt loam, 1 to 5 percent slopes	22	IIIe-2	41	VIe-1	43	Loamy Plains	48
Mg	Manvel silt loam, gullied	22	------	--	VIIe-1	44	1/	--
Mn	Manvel silt loam, wet	22	------	--	VIw-1	44	Salt Meadow	49
MoD	Manzanola clay loam, 2 to 9 percent slopes	23	------	--	VIe-1	43	Loamy Plains	48
MpA	Manzanola silty clay loam, 0 to 2 percent slopes	23	------	--	VIw-2	44	Saline Overflow	49
MsD	Midway-Shale outcrop complex, 1 to 9 percent slopes	23	------	--	VIIs-1	44	Shaly Plains	50
Mv	Minnequa-Manvel loams	24	------	--	VIe-1	43	Loamy Plains	48
NdE	Nederland stony sandy loam, 9 to 25 percent slopes	25	------	--	VIIs-3	45	Cobbly Foothills	47
NeD	Neville sandy loam, 3 to 9 percent slopes	26	------	--	VIe-3	43	Sandy Foothills	50
NnD	Nunn stony loam, 3 to 9 percent slopes	26	------	--	IVe-3	43	Loamy Foothills	48
NuC	Nunn clay loam, 0 to 5 percent slopes	26	------	--	IIIe-1	42	Loamy Foothills	48
NuD	Nunn clay loam, 5 to 9 percent slopes	27	------	--	IVe-3	43	Loamy Foothills	48
Oe	Olney loamy sand	27	------	--	IVe-2	42	Sandy Plains	50
Of	Olney sandy loam	27	------	--	IVe-2	42	Sandy Plains	50
OoA	Otero sandy loam, 0 to 1 percent slopes	28	I	40	VIe-3	43	Sandy Plains	50

Map symbol	Mapping unit	Page	Capability unit Irrigated Symbol	Page	Nonirrigated Symbol	Page	Range site Name	Page
OoC	Otero sandy loam, 1 to 5 percent slopes	28	IIIe-1	41	VIe-3	43	Sandy Plains	50
OrD	Otero gravelly sandy loam, 3 to 9 percent slopes	28	IIIe-1	41	VIe-3	43	Sandy Plains	50
OtA	Otero clay loam, 0 to 1 percent slopes	28	I	40	------	--	----------	--
OtB	Otero clay loam, 1 to 3 percent slopes	28	IIe-1	40	------	--	----------	--
PmE	Penrose-Minnequa complex, 1 to 15 percent slopes	29	------	--	VIIs-3	45	----------	--
	Penrose part	--	------	--	------	--	Limestone Breaks	48
	Manvel and Minnequa parts	--	------	--	------	--	Loamy Plains	48
PrF	Penrose-Rock outcrop complex, 25 to 65 percent slopes	29	------	--	VIIs-3	45	----------	--
	Penrose part	--	------	--	------	--	Limestone Breaks	48
	Rock outcrop part	--	------	--	------	--	----------	--
PW	Pinata-Wetmore association	30	------	--	VIIs-4	45	----------	--
Ra	Razor clay loam	31	------	--	VIe-2	43	Alkaline Plains	47
Re2	Razor clay, eroded	31	------	--	VIe-2	43	Alkaline Plains	47
RfA	Rocky Ford silty clay loam, 0 to 1 percent slopes	31	I	40	------	--	----------	--
RfB	Rocky Ford silty clay loam, 1 to 3 percent slopes	31	IIe-1	40	------	--	----------	--
Rg	Rocky Ford silty clay loam, wet	31	IIw-1	40	------	--	----------	--
SaE	Schamber gravelly sandy loam, 5 to 25 percent slopes	32	------	--	VIIs-2	44	Gravel Breaks	48
SgD	Shingle silty clay loam, 1 to 9 percent slopes	33	------	--	VIIs-1	44	Shaly Plains	50
Sh	Stoneham loam	33	------	--	VIe-1	43	Loamy Plains	48
StE	Stroupe extremely stony loam, 9 to 25 percent slopes	34	------	--	VIIs-3	45	Shallow Foothills	51
TM	Table Mountain association	34	IIe-1	40	IIIe-1	41	Loamy Foothills	48
ToD	Travessilla sandy loam, 1 to 9 percent slopes	35	------	--	VIIs-3	45	Sandstone Breaks	49
TrG	Travessilla-Rock outcrop complex, 30 to 90 percent slopes	35	------	--	VIIs-3	45	----------	--
	Travessilla part	--	------	--	------	--	Sandstone Breaks	49
	Rock outcrop part	--	------	--	------	--	----------	--
Va	Valent loamy sand	36	------	--	VIe-3	43	Deep Sand	47
VmE	Vamer-Rock outcrop complex, 5 to 25 percent slopes	36	------	--	VIIs-4	45	----------	--
Vn	Vona loamy sand	37	------	--	VIe-3	43	Sandy Plains	50
Vo	Vona sandy loam	37	------	--	VIe-3	43	Sandy Plains	50
Vs2	Vona-Otero complex, eroded	37	------	--	VIe-3	43	Sandy Plains	50
WE	Wetmore-Mortenson association	37	------	--	VIIs-4	45	----------	--
Wk	Wiley-Kim loams	38	------	--	VIe-1	43	Loamy Plains	48
Wo	Wormser silt loam	39	------	--	VIe-4	43	Clayey Foothills	47

1/ Too variable to classify in a range site.

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U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
COLORADO AGRICULTURAL EXPERIMENT STATION

GENERAL SOIL MAP

PUEBLO AREA, COLORADO
PARTS OF PUEBLO AND CUSTER COUNTIES

Scale 1:380,160
1 0 1 2 3 4 5 6 Miles

N

SOIL ASSOCIATIONS

SOILS ON FOOTHILLS AND MOUNTAINS

1 — Wetmore-Larkson-Pinata association: Deep to shallow, well drained gravelly sandy loams, stony loams, and very stony loams that formed in materials weathered from granite, loess, or sandstone

2 — Nunn-Stroupe-Holderness association: Deep to shallow, well drained clay loams, extremely stony loams, and silt loams that formed in loess, alluvium, and materials weathered from sandstone, limestone, and shale

SOILS ON DISSECTED PLAINS

3 — Travessilla association: Shallow sandy loams that formed in material weathered from interbedded sandstone and shale

4 — Penrose-Minnequa association: Shallow and moderately deep, somewhat excessively drained and well drained, channery loams and loams that formed in materials weathered from interbedded limestone and shale

SOILS ON PLAINS

5 — Limon-Razor-Midway association: Deep to shallow, well drained silty clays, silty clay loams, clay loams, and clays that formed in materials weathered from shale

6 — Valent association: Deep, excessively drained loamy sands and sands that formed in eolian sand

7 — Olney-Vona association: Deep, well drained sandy loams and loamy sands that formed in eolian material

8 — Wiley-Kim association: Deep, well drained loams and silt loams that formed in loess and loamy alluvium

9 — Manvel association: Deep, well drained silt loams that formed in calcareous silty alluvium

10 — Stoneham-Adena-Manzanola association: Deep, well drained loams, clay loams, sandy loams, and silty clay loams that formed in loess and in loamy and clayey alluvium

SOILS ON TERRACES AND FLOOD PLAINS

11 — Cascajo-Schamber association: Deep, well drained to excessively drained gravelly sandy loams that formed in coarse textured alluvium on high terraces and terrace edges

12 — Rocky Ford association: Deep, well drained silty clay loams that formed in silty alluvium on terraces

13 — Las Animas-Glenberg-Apishapa association: Deep, somewhat poorly drained to well drained fine sandy loams and silty clays that formed in alluvium on flood plains

Compiled 1977

Each area outlined on this map consists of more than one kind of soil. The map is thus meant for general planning rather than a basis for decisions on the use of specific tracts.

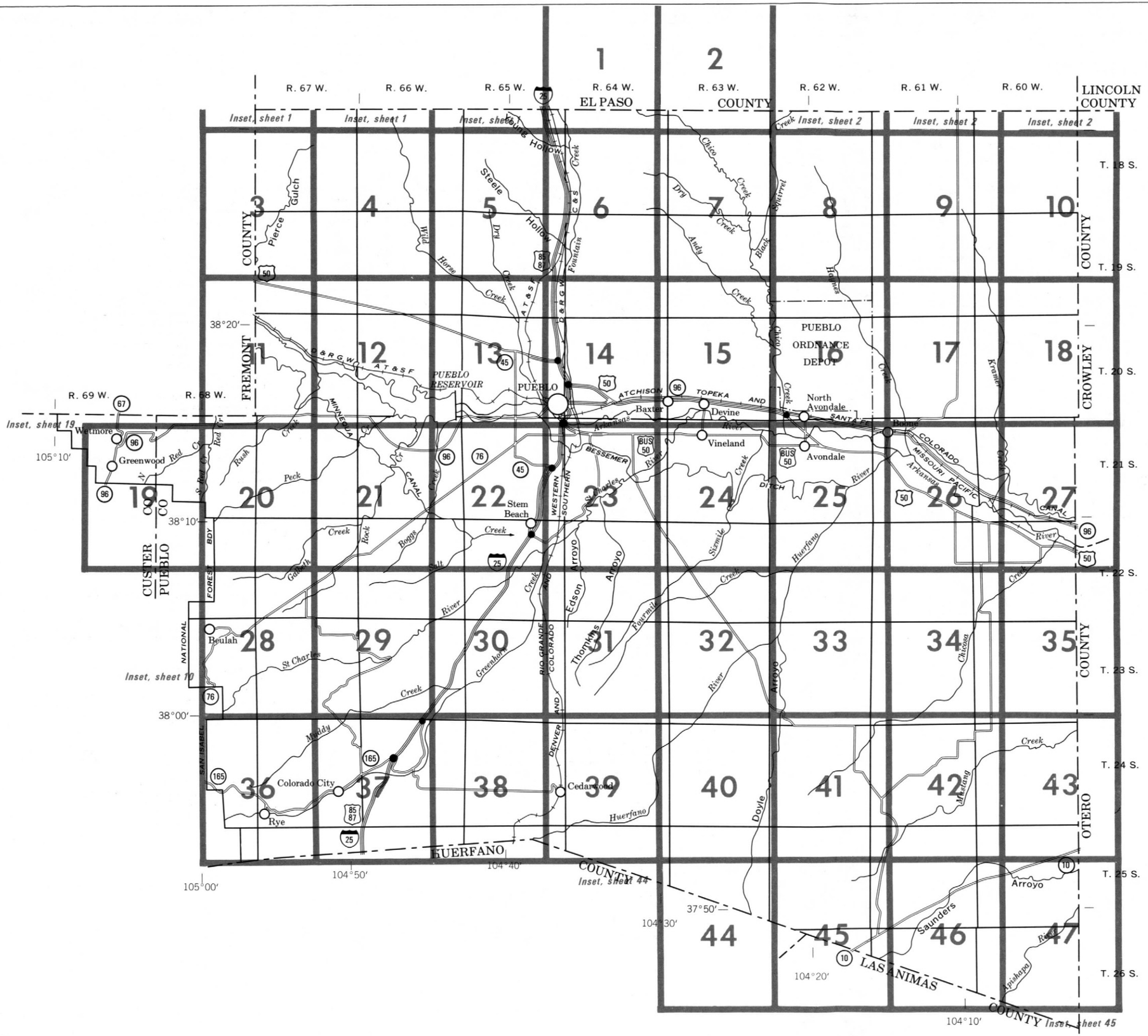
INDEX TO MAP SHEETS

PUEBLO AREA, COLORADO

PARTS OF PUEBLO AND CUSTER COUNTIES

Scale 1:380,160

1 0 1 2 3 4 5 6 Miles



CONVENTIONAL AND SPECIAL SYMBOLS LEGEND

CULTURAL FEATURES

BOUNDARIES

- National, state or province
- County or parish
- Minor civil division
- Reservation (national forest or park, state forest or park, and large airport)
- Land grant
- Limit of soil survey (label)
- Field sheet matchline & neatline

AD HOC BOUNDARY (label)

- Small airport, airfield, park, oilfield cemetery or flood pool (Davis Airstrip; FLOOD POOL LINE)

STATE COORDINATE TICK

LAND DIVISION CORNERS (sections and land grants)

ROADS

- Divided (median shown if scale permits)
- Other roads
- Trail

ROAD EMBLEMS & DESIGNATIONS

- Interstate (79)
- Federal (410)
- State (52)
- County, farm or ranch (378)

RAILROAD

POWER TRANSMISSION LINE (normally not shown)

PIPE LINE (normally not shown)

FENCE (normally not shown)

LEVEES

- Without road
- With road
- With railroad

DAMS

- Large (to scale)
- Medium or small (water; w)

PITS

- Gravel pit
- Mine or quarry

MISCELLANEOUS CULTURAL FEATURES

- Farmstead, house (omit in urban areas)
- Church
- School
- Indian mound (label) (Indian Mound)
- Located object (label) (Tower)
- Tank (label) (GAS)
- Wells, oil or gas
- Windmill
- Kitchen midden

WATER FEATURES

DRAINAGE

- Perennial, double line
- Perennial, single line
- Intermittent
- Drainage end
- Canals or ditches
  - Double-line (label) (CANAL)
  - Drainage and/or irrigation

LAKES, PONDS AND RESERVOIRS

- Perennial (water; w)
- Intermittent (int; i)

MISCELLANEOUS WATER FEATURES

- Marsh or swamp
- Spring
- Well, artesian
- Well, irrigation
- Wet spot

SPECIAL SYMBOLS FOR SOIL SURVEY

SOIL DELINEATIONS AND SYMBOLS (CeA; FoB2)

ESCARPMENTS

- Bedrock (points down slope)
- Other than bedrock (points down slope)

SHORT STEEP SLOPE

GULLY

DEPRESSION OR SINK

SOIL SAMPLE SITE (normally not shown)

MISCELLANEOUS

- Blowout
- Clay spot
- Gravelly spot
- Gumbo, slick or scabby spot (sodic)
- Dumps and other similar non soil areas
- Prominent hill or peak
- Rock outcrop (includes sandstone and shale)
- Saline spot
- Sandy spot
- Severely eroded spot
- Slide or slip (tips point upslope)
- Stony spot, very stony spot

SOIL LEGEND

The first letter, always a capital, is the initial letter of the soil name. The second letter is a capital if the mapping unit is broadly defined * ; otherwise, it is a small letter. The third letter, always a capital, A, B, C, D, E, or F shows the slope class. Most symbols without slope letters are those of nearly level soils, but some are for soil associations, with a fair to considerable range of slope. A final number, 2, in the symbol shows that the soil has been eroded.

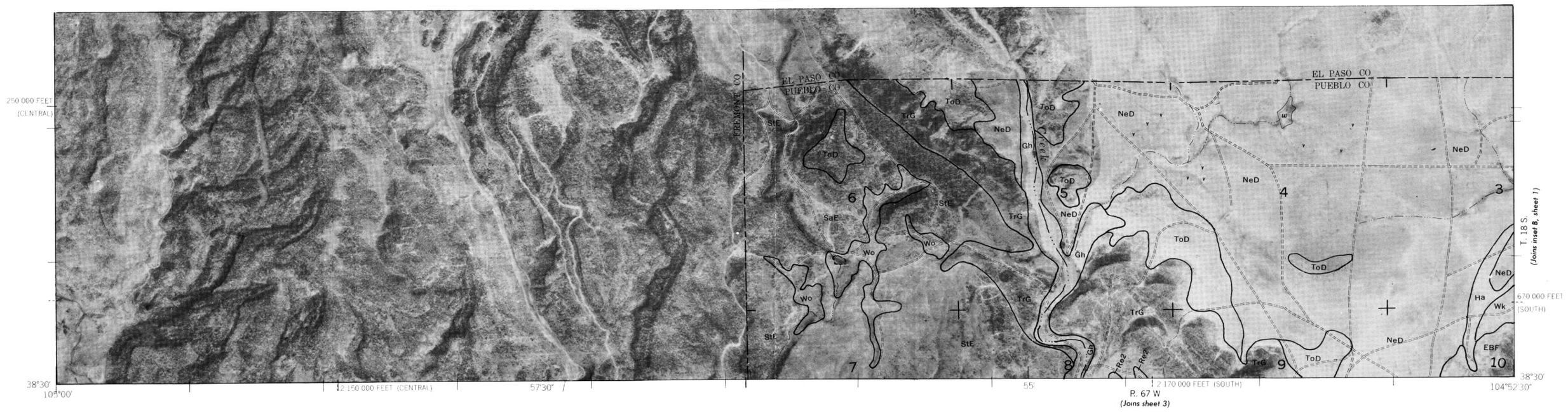
SYMBOL	NAME
Ab	Absted clay loam
Am	Adena-Manvel loams
Ap	Apishapa silty clay
AR	Arvada-Keyner association
Bc	Baca silty clay loam
Bk	Bankard sand
Bm	Bloom silt loam
CaE	Cascajo very gravelly sandy loam, 5 to 25 percent slopes
CsE	Cascajo-Shale outcrop complex, 5 to 30 percent slopes
DeD	Denver clay loam, 3 to 9 percent slopes
Dw	Dwyer loamy sand
EBF	Eutroboralfs, steep
GcA	Gilcrest sandy loam, 0 to 2 percent slopes
GeD	Gilcrest gravelly sandy loam, 3 to 9 percent slopes
GfC	Gilcrest complex, 3 to 6 percent slopes
Gh	Glenberg-Haverson fine sandy loams
Ha	Haverson silt loam
He	Heldt silty clay loam, 2 to 6 percent slopes
Ho	Holderness silt loam, 3 to 9 percent slopes
Ke	Keyner loamy sand, wet
Km	Kim fine sandy loam
LaE	LaPorte channery loam, 3 to 25 percent slopes
LbD	Larkson loam, 6 to 12 percent slopes
LcE	Larkson stony loam, 5 to 20 percent slopes
Lm	Las Animas fine sandy loam
LnA	Limon silty clay loam, 0 to 2 percent slopes
LnB	Limon silty clay loam, 2 to 5 percent slopes
LoA	Limon silty clay, 0 to 2 percent slopes
LvB	Limon silty clay, 0 to 5 percent slopes, gullied
MaA	Manvel silt loam, 0 to 1 percent slopes
MaB	Manvel silt loam, 1 to 5 percent slopes
Mg	Manvel silt loam, gullied
Mn	Manvel silt loam, wet
MoD	Manzanola clay loam, 2 to 9 percent slopes
MpA	Manzanola silty clay loam, 0 to 2 percent slopes
MsD	Midway-Shale outcrop complex, 1 to 9 percent slopes
Mv	Minnequa-Manvel loams
NdE	Nederland stony sandy loam, 9 to 25 percent slopes
NeD	Neville sandy loam, 3 to 9 percent slopes
NnD	Nunn stony loam, 3 to 9 percent slopes
NuC	Nunn clay loam, 0 to 5 percent slopes
NuD	Nunn clay loam, 5 to 9 percent slopes
Oe	Olney loamy sand
Of	Olney sandy loam
OoA	Otero sandy loam, 0 to 1 percent slopes
OoC	Otero sandy loam, 1 to 5 percent slopes
OrD	Otero gravelly sandy loam, 3 to 9 percent slopes
OtA	Otero clay loam, 0 to 1 percent slopes
OtB	Otero clay loam, 1 to 3 percent slopes
PmE	Penrose-Minnequa complex, 1 to 15 percent slopes
PrF	Penrose-Rock outcrop complex, 25 to 65 percent slopes
PW	Pinata-Wetmore association
Ra	Razor clay loam
Re2	Razor clay, eroded
RfA	Rocky Ford silty clay loam, 0 to 1 percent slopes
RfB	Rocky Ford silty clay loam, 1 to 3 percent slopes
Rg	Rocky Ford silty clay loam, wet
SaE	Schamber gravelly sandy loam, 5 to 25 percent slopes
SgD	Shingle silty clay loam, 1 to 9 percent slopes
Sh	Stoneham loam
StE	Stroupe extremely stony loam, 9 to 25 percent slopes
TM	Table Mountain association
ToD	Travessilla sandy loam, 1 to 9 percent slopes
TrG	Travessilla-Rock outcrop complex, 30 to 90 percent slopes
Va	Valent loamy sand
VmE	Vamer-Rock outcrop complex, 5 to 25 percent slopes
Vn	Vona loamy sand
Vo	Vona sandy loam
Vs2	Vona-Otero complex, eroded
WE	Wetmore-Mortenson association
Wk	Wiley-Kim loams
Wo	Wormser silt loam

* The composition of these units is more variable than that of the others in the survey area but has been controlled well enough to be interpreted for the expected use of the soils.

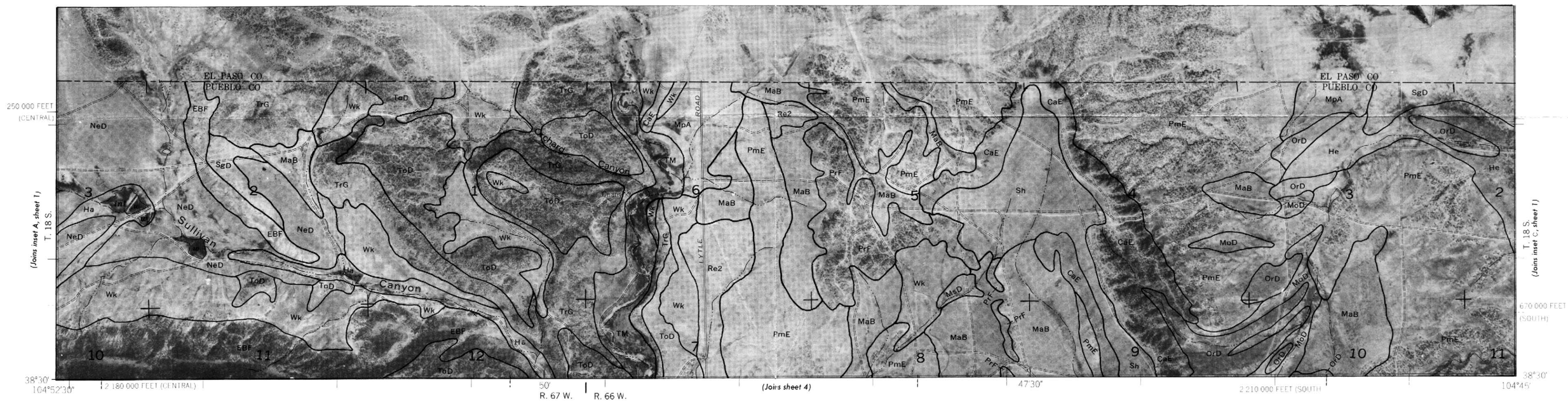
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SHEET NO. 1
PUEBLO AREA, COLORADO
PARTS OF PUEBLO AND CUSTER COUNTIES

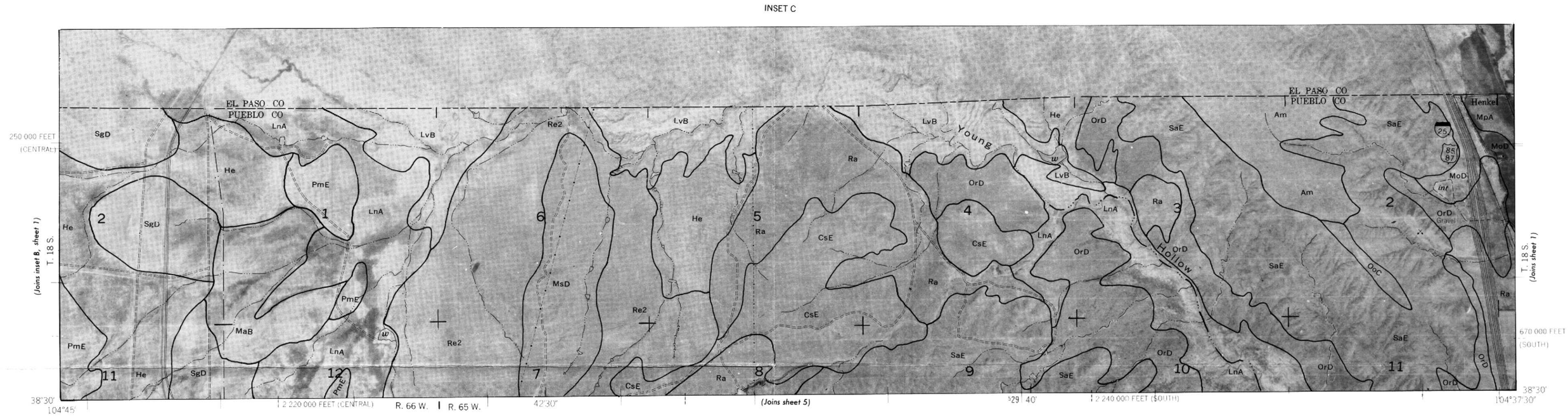
INSET A

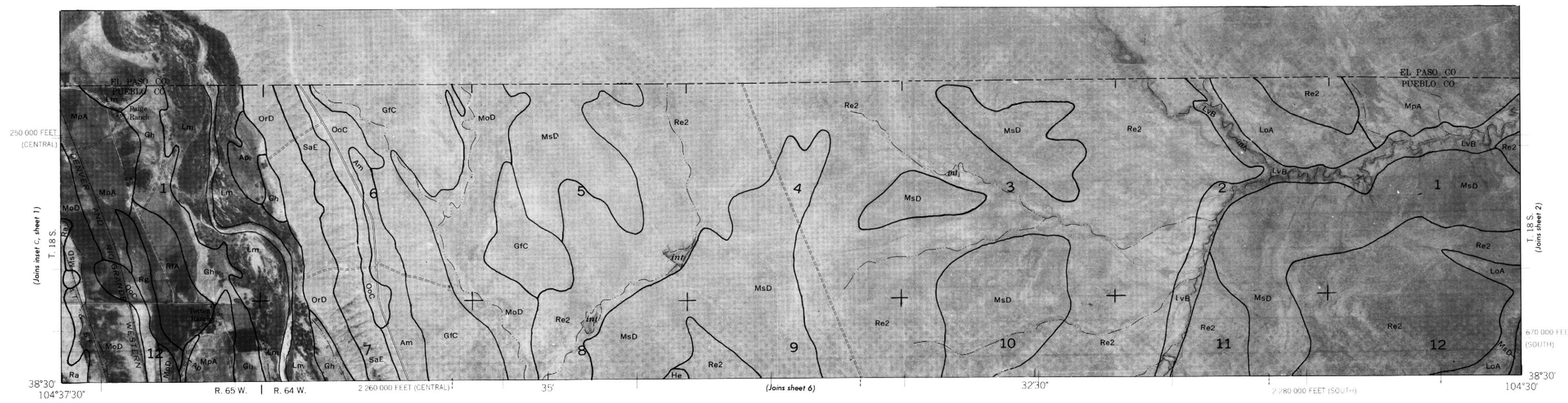


INSET B



INSET C



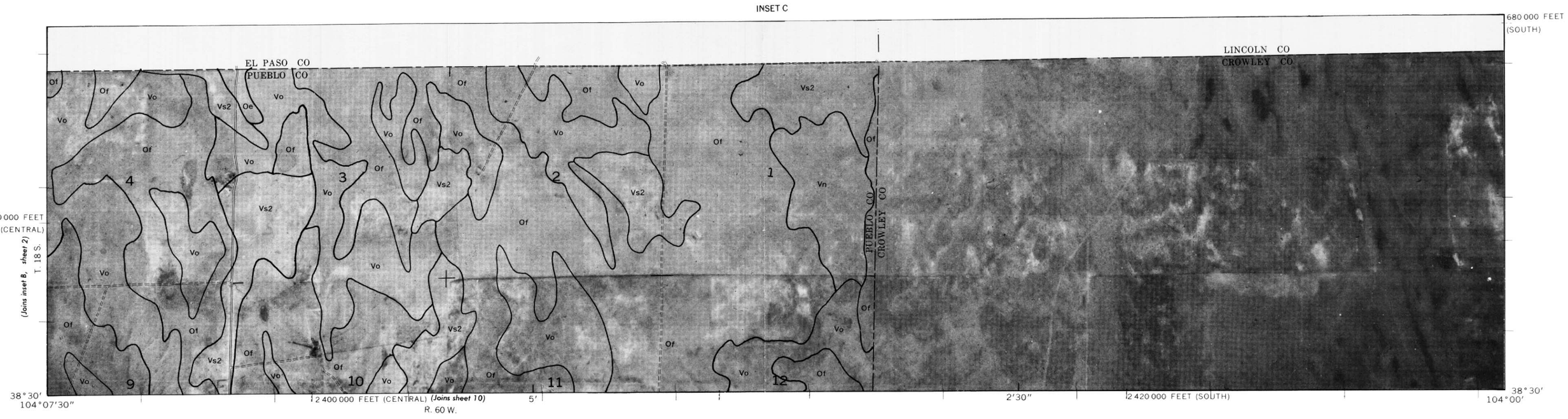


This soil survey was compiled in 1977 by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

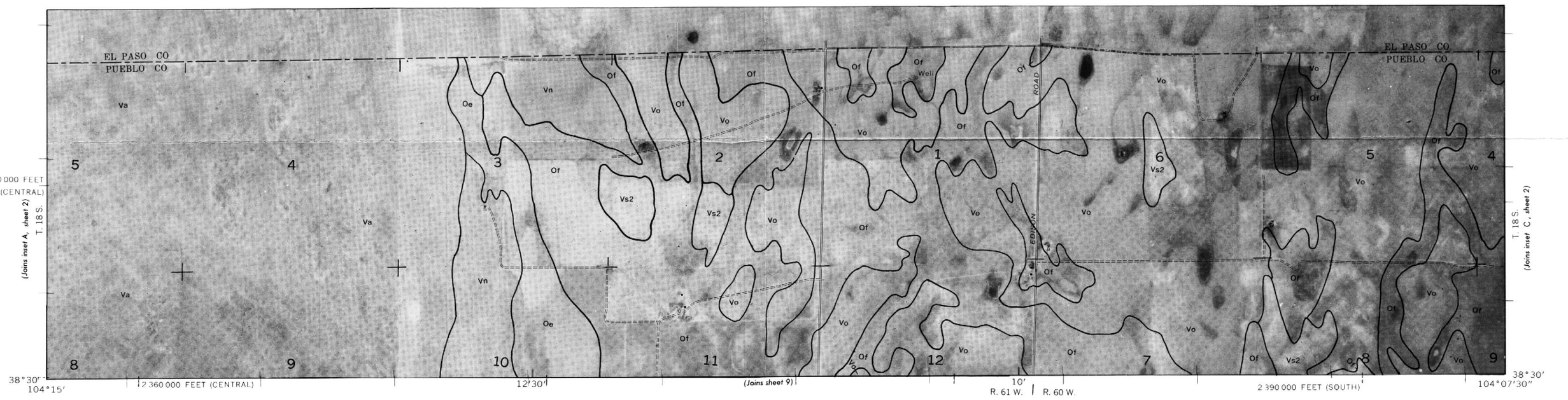
1 ¾ ½ ¼ 0 1 2 Miles
5000 4000 3000 2000 1000 0 5000 10000 Feet
Scale 1:24000

Orthophotobase compiled from 1974 and 1975 aerial photography by the U.S. Department of The Interior, Geological Survey. Planimetric detail obtained from 7½ minute series maps. 10,000-foot grid based on state coordinate system.

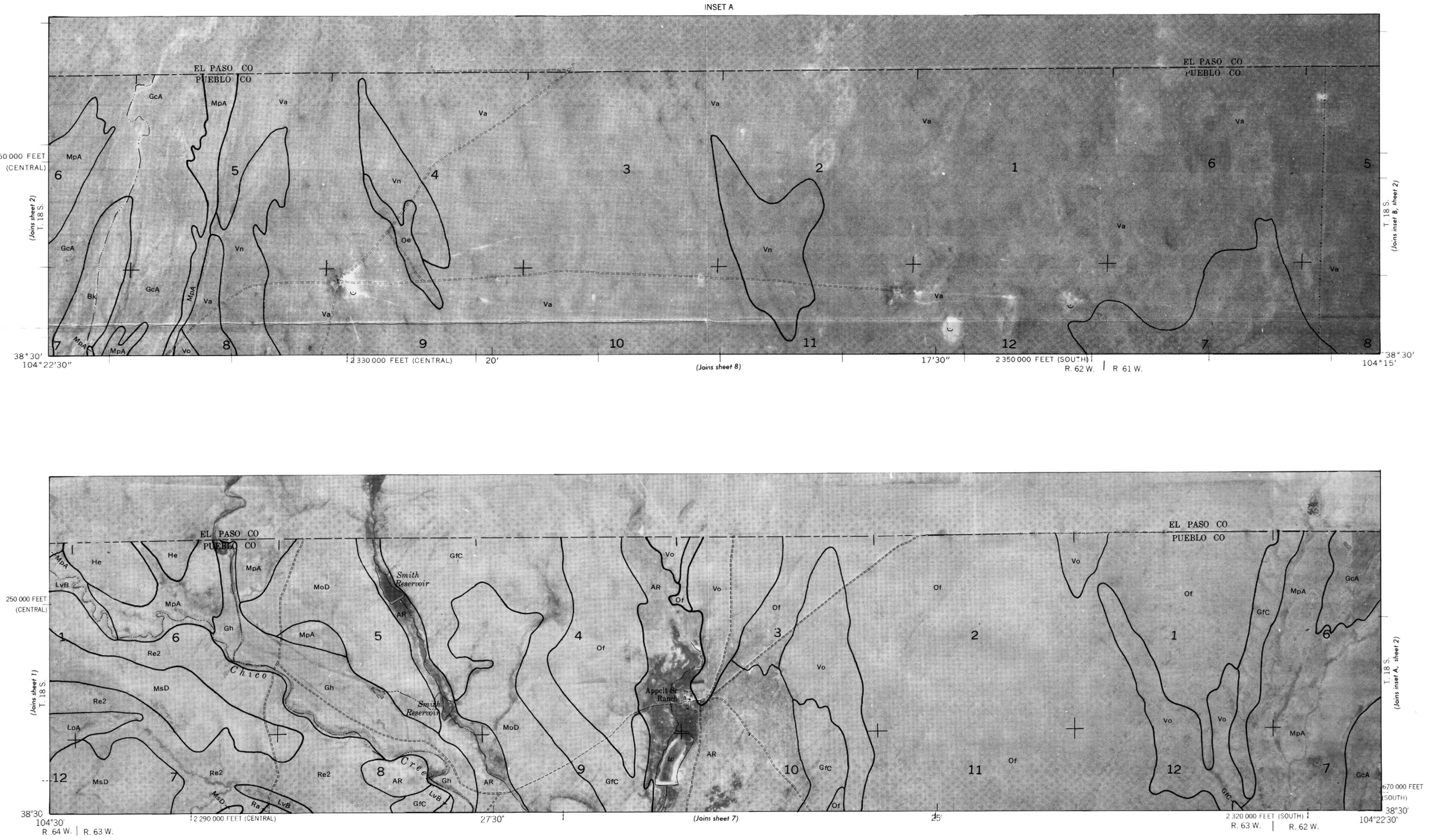
INSET C



INSET B



INSET A



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1 ¾ ½ ¼ 0 1 2 Miles
5000 4000 3000 2000 1000 0 5000 10000 Feet
Scale 1:24000

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PUEBLO AREA, COLORADO, PARTS OF PUEBLO AND CUSTER COUNTIES NO. 2

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SHEET NO. 3
PUEBLO AREA, COLORADO
PARTS OF PUEBLO AND CUSTER COUNTIES

(Joins inset A, sheet 1)

105°00' 38°30' | 2 150 000 FEET (CENTRAL) | 57'30" | R. 67 W. | 55' | 2 170 000 FEET (SOUTH) | 104°52'30" 38°30'

240 000 FEET (CENTRAL) | FREMONT CO | PUEBLO CO | 660 000 FEET (SOUTH)

27'30"

T. 19 S. | T. 18 S.

25'

630 000 FEET (SOUTH) | 200 000 FEET (CENTRAL)

38°22'30" 105°00' | 2 150 000 FEET (SOUTH) | 57'30" | 55' | 2 170 000 FEET (CENTRAL) | 38°22'30" 104°52'30"

(Joins sheet 4)

R. 67 W.
(Joins sheet 11)

Scale 1:24000

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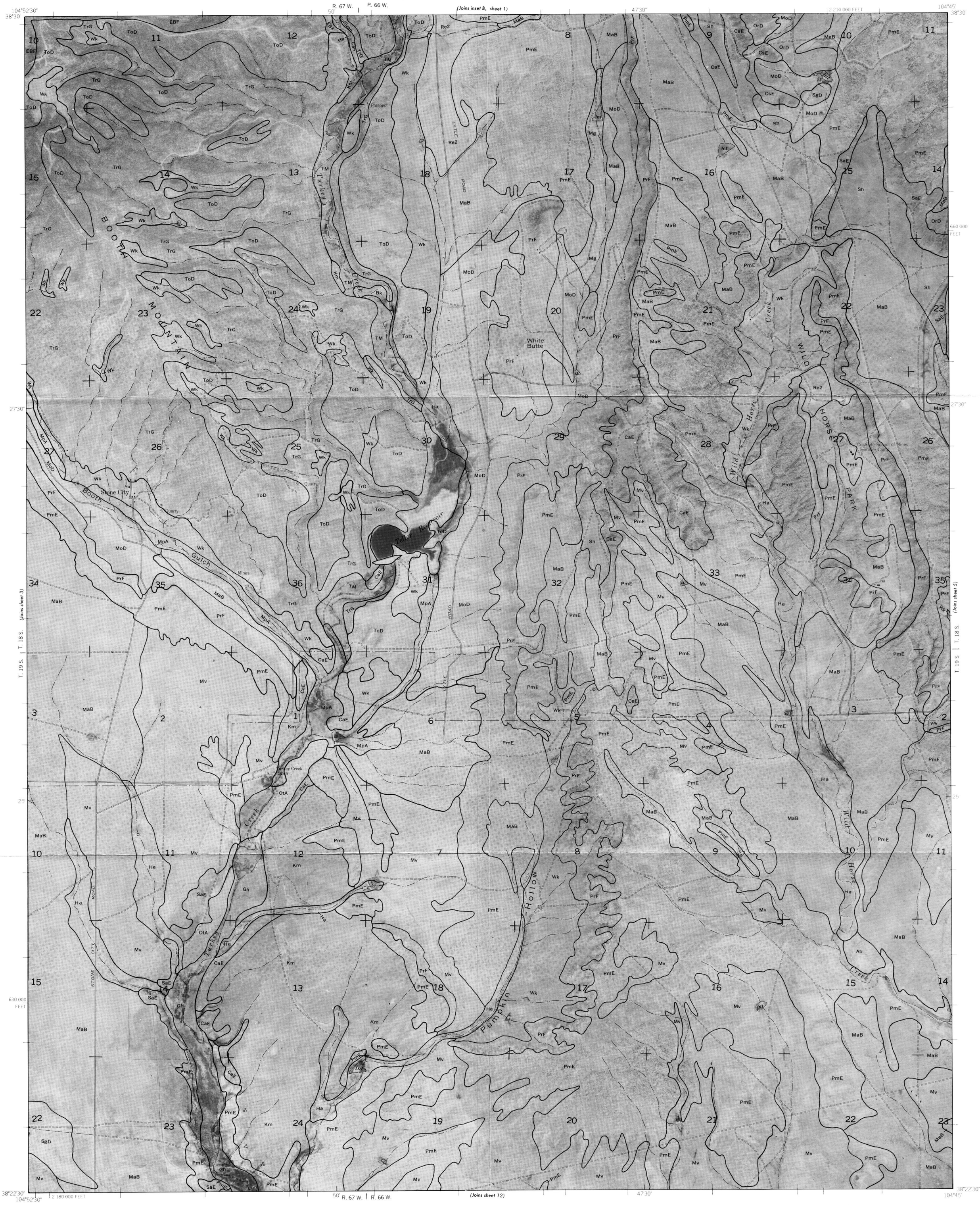
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SHEET NO. 4
PUEBLO AREA, COLORADO
PARTS OF PUEBLO AND CUSTER COUNTIES



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Scale 1:24000

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PUEBLO AREA, COLORADO, PARTS OF PUEBLO AND CUSTER COUNTIES NO. 4

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SHEET NO. 5
PUEBLO AREA, COLORADO
PARTS OF PUEBLO AND CUSTER COUNTIES

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Scale 1:24000

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U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SHEET NO. 6
PUEBLO AREA, COLORADO
PARTS OF PUEBLO AND CUSTER COUNTIES

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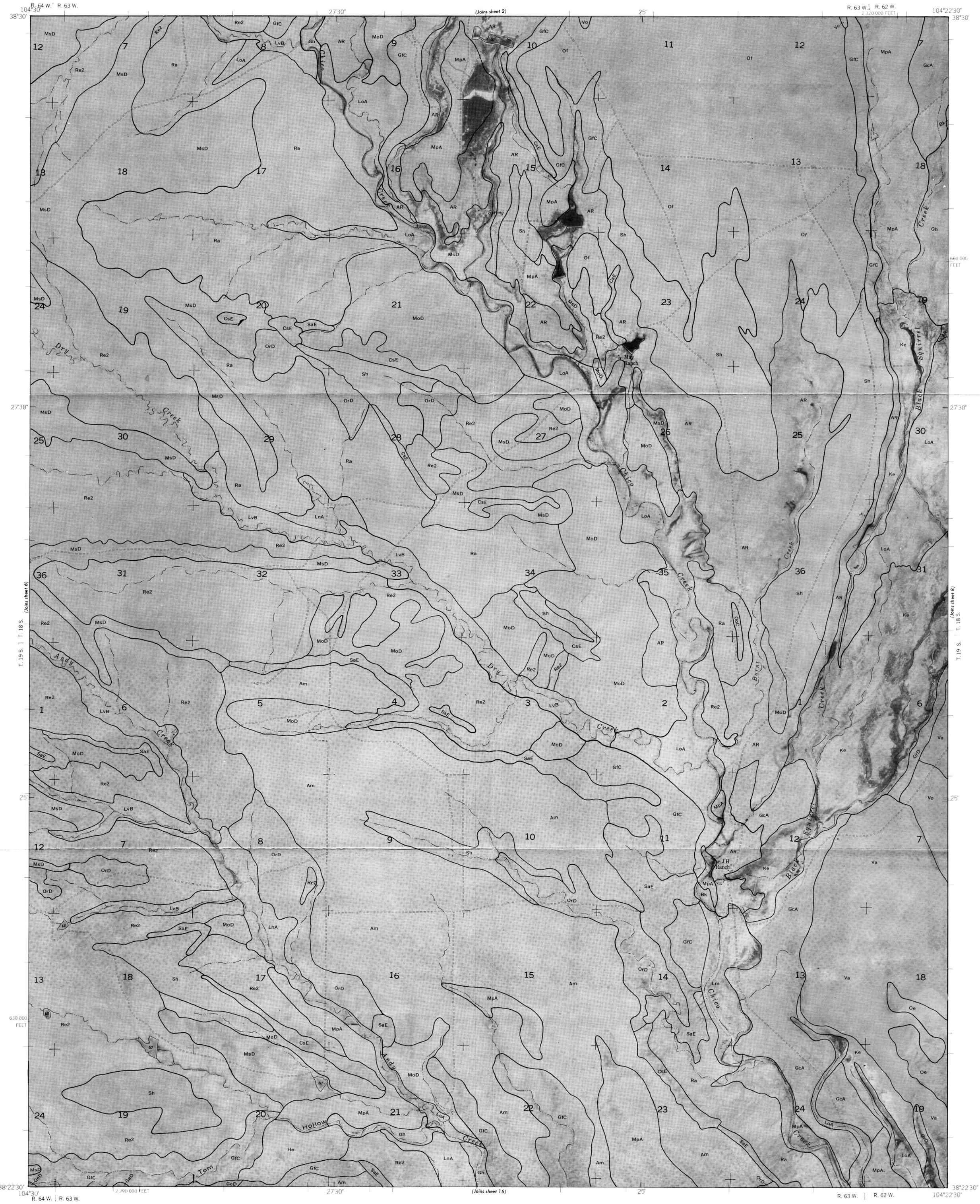
PUEBLO AREA, COLORADO, PARTS OF PUEBLO AND CUSTER COUNTIES NO. 6



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1 ¾ ½ ¼ 0 1 2 Miles
5000 4000 3000 2000 1000 0 5000 10000 Feet
Scale 1:24000

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U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SHEET NO. 8
PUEBLO AREA, COLORADO
PARTS OF PUEBLO AND CUSTER COUNTIES

104°22'30" 38°30' | 20' | (Joins inset A, sheet 2) | 17'30" | R. 62 W. | R. 61 W. | 2 350 000 FEET | 104°15' 38°30'

27'30"

660 000 FEET

T. 19 S. | T. 18 S. (Joins sheet 7)

(Joins sheet 9) T. 19 S. | T. 18 S.

25

630 000 FEET

38°22'30" 104°22'30" | 2 330 000 FEET | 20' | (Joins sheet 16) | 17'30" | R. 62 W. | R. 61 W. | 38°22'30" 104°15'

Hoyt Creek

SPILLWAY

This soil survey was compiled in 1977 by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

1 ¾ ½ ¼ 0 1 2 Miles
5000 4000 3000 2000 1000 0 5000 10000 Feet
Scale 1:24000

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PUEBLO AREA, COLORADO, PARTS OF PUEBLO AND CUSTER COUNTIES NO. 8

(Joins inset B, sheet 2)
(Joins sheet 8)
(Joins sheet 10)
(Joins sheet 17)

104°15′ 12′30″ R. 61 W. 10′ R. 60 W. 104°07′30″
38°30′ 27′30″ 25′ 38°22′30″
2 390 000 FEET 670 000 FEET 630 000 FEET 2 360 000 FEET
T. 19 S. | T. 18 S.

Kramer Creek

Highlands Church

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1 ¾ ½ ¼ 0 1 2 Miles
5 000 4 000 3 000 2 000 1 000 0 5 000 10 000 Feet
Scale 1:24 000

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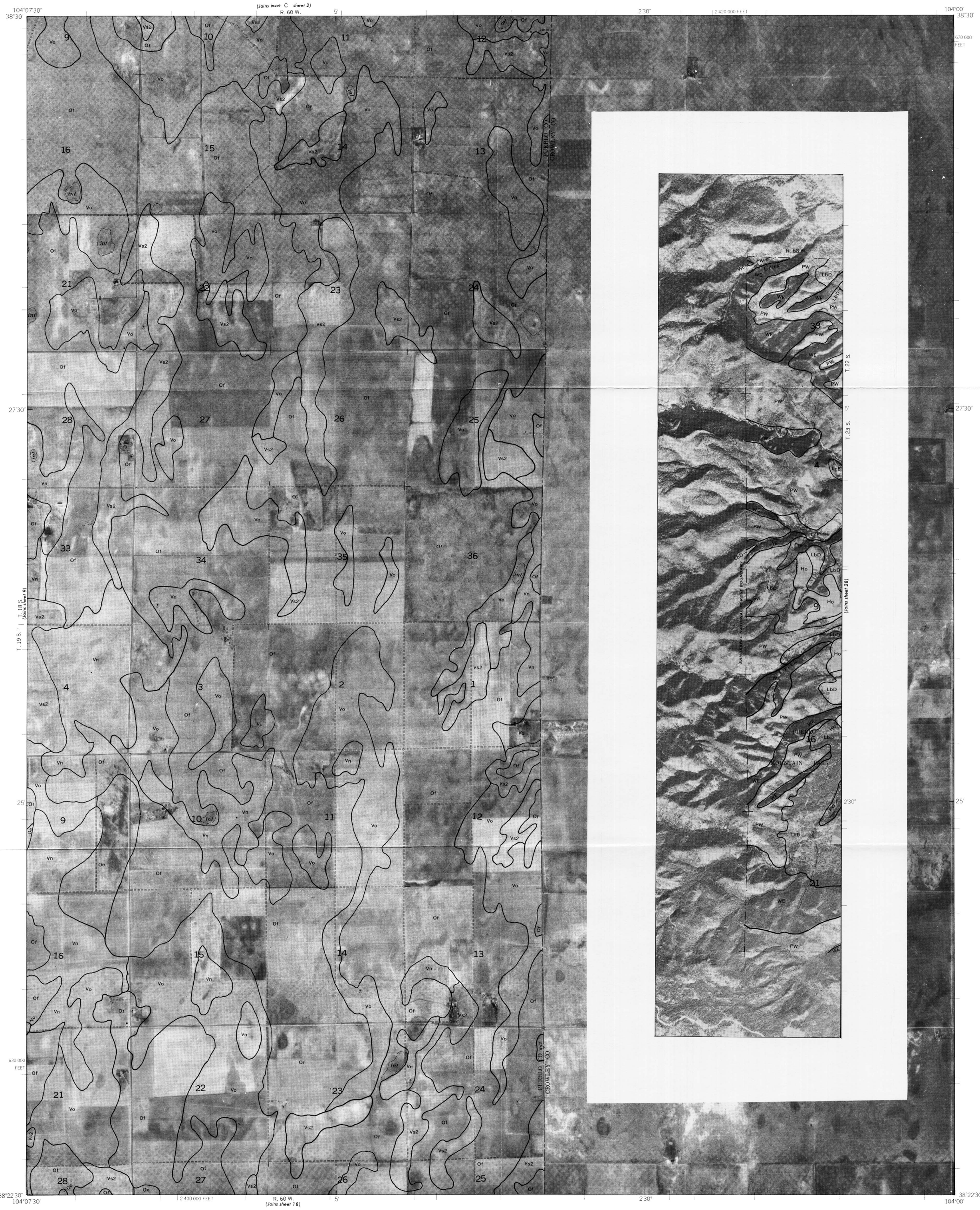
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SHEET NO. 10
PUEBLO AREA, COLORADO
PARTS OF PUEBLO AND CUSTER COUNTIES



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U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SHEET NO. 12
PUEBLO AREA, COLORADO
PARTS OF PUEBLO AND CUSTER COUNTIES

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U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SHEET NO. 13
PUEBLO AREA, COLORADO
PARTS OF PUEBLO AND CUSTER COUNTIES

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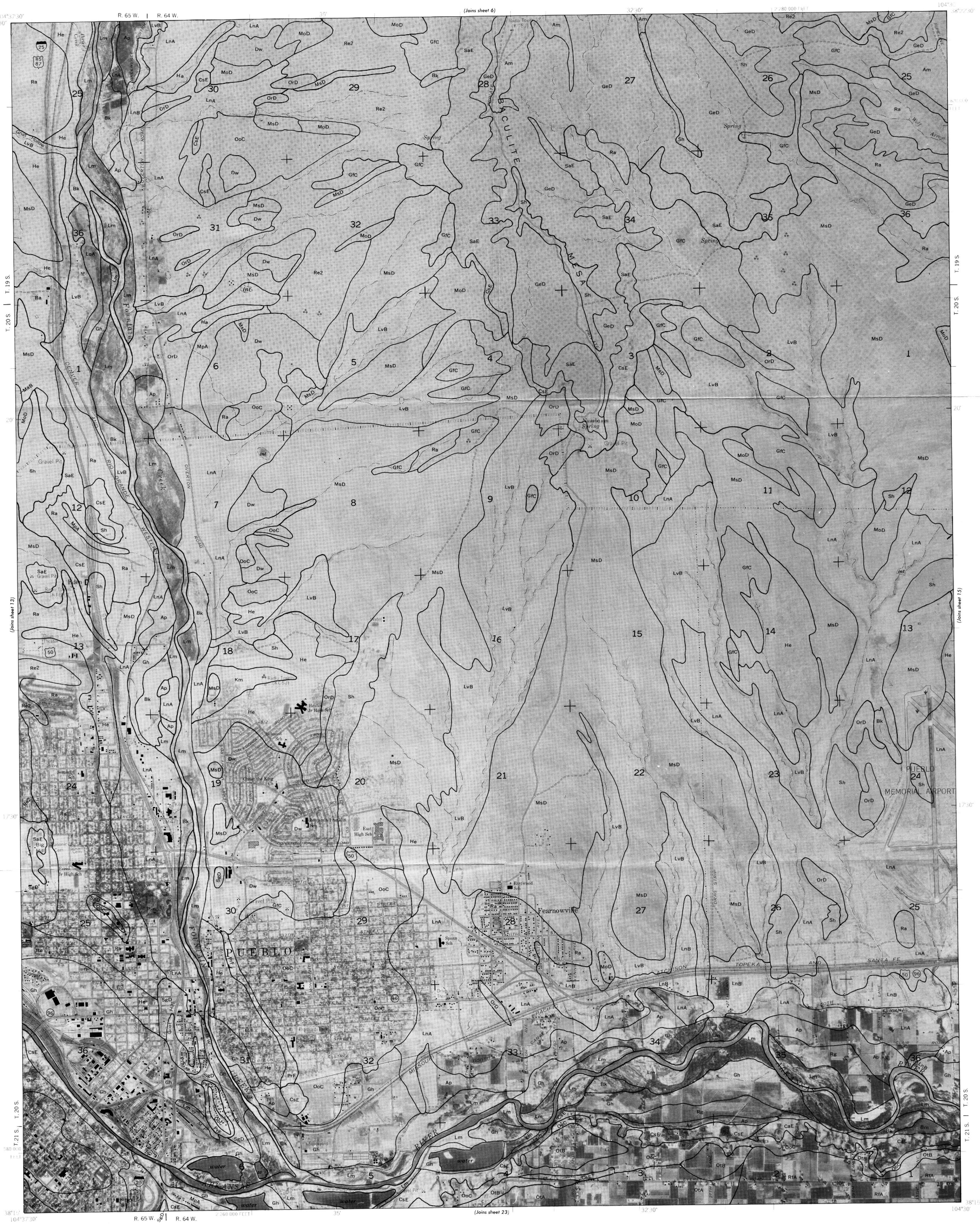
SOIL CONSERVATION SERVICE

SHEET NO. 14
PUEBLO AREA, COLORADO
PARTS OF PUEBLO AND CUSTER COUNTIES



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1 ¾ ½ ¼ 0 1 2 Miles
5000 4000 3000 2000 1000 0 5000 10000 Feet
Scale 1:24000

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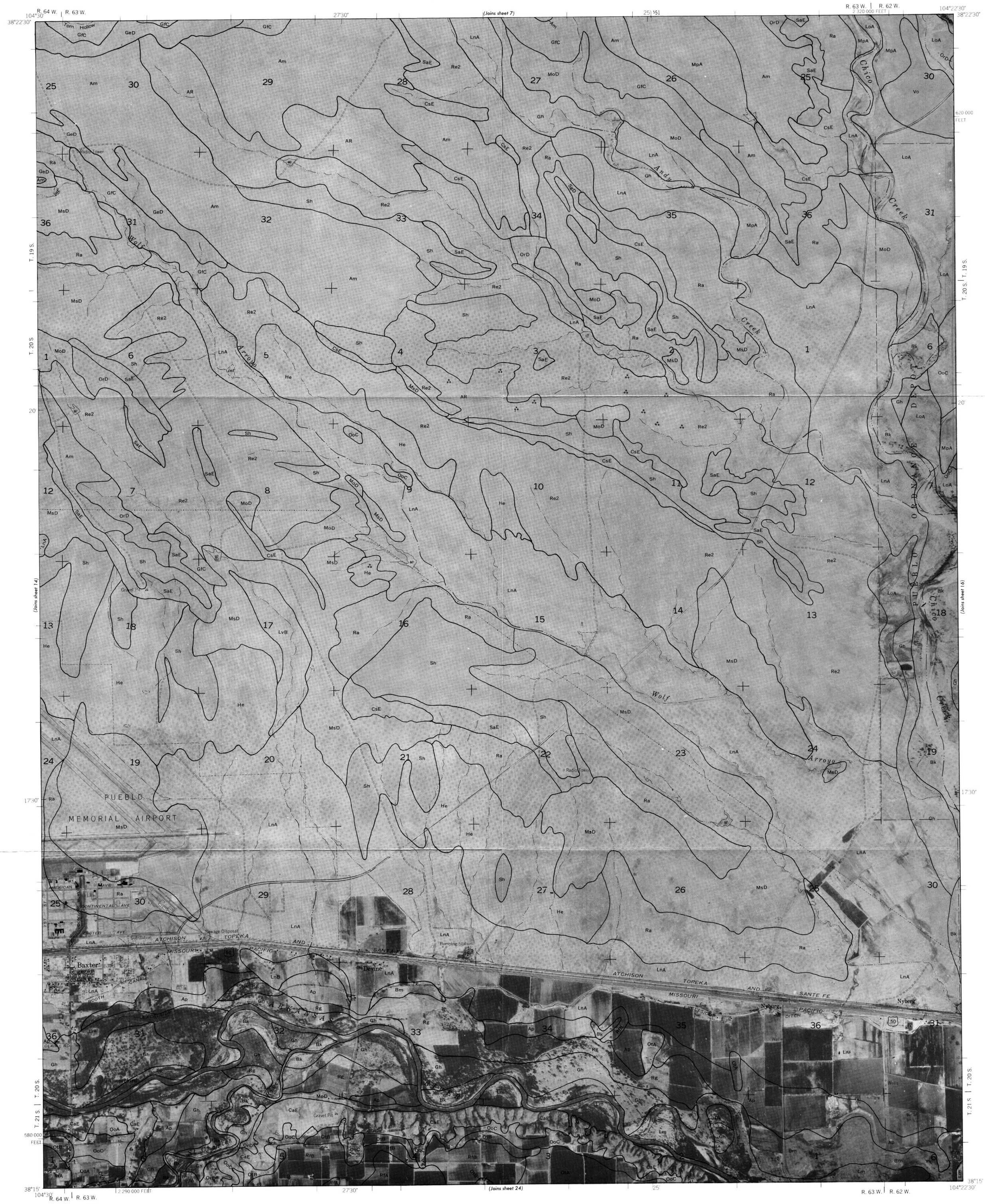
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SHEET NO. 15
PUEBLO AREA, COLORADO
PARTS OF PUEBLO AND CUSTER COUNTIES



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Scale 1:24000

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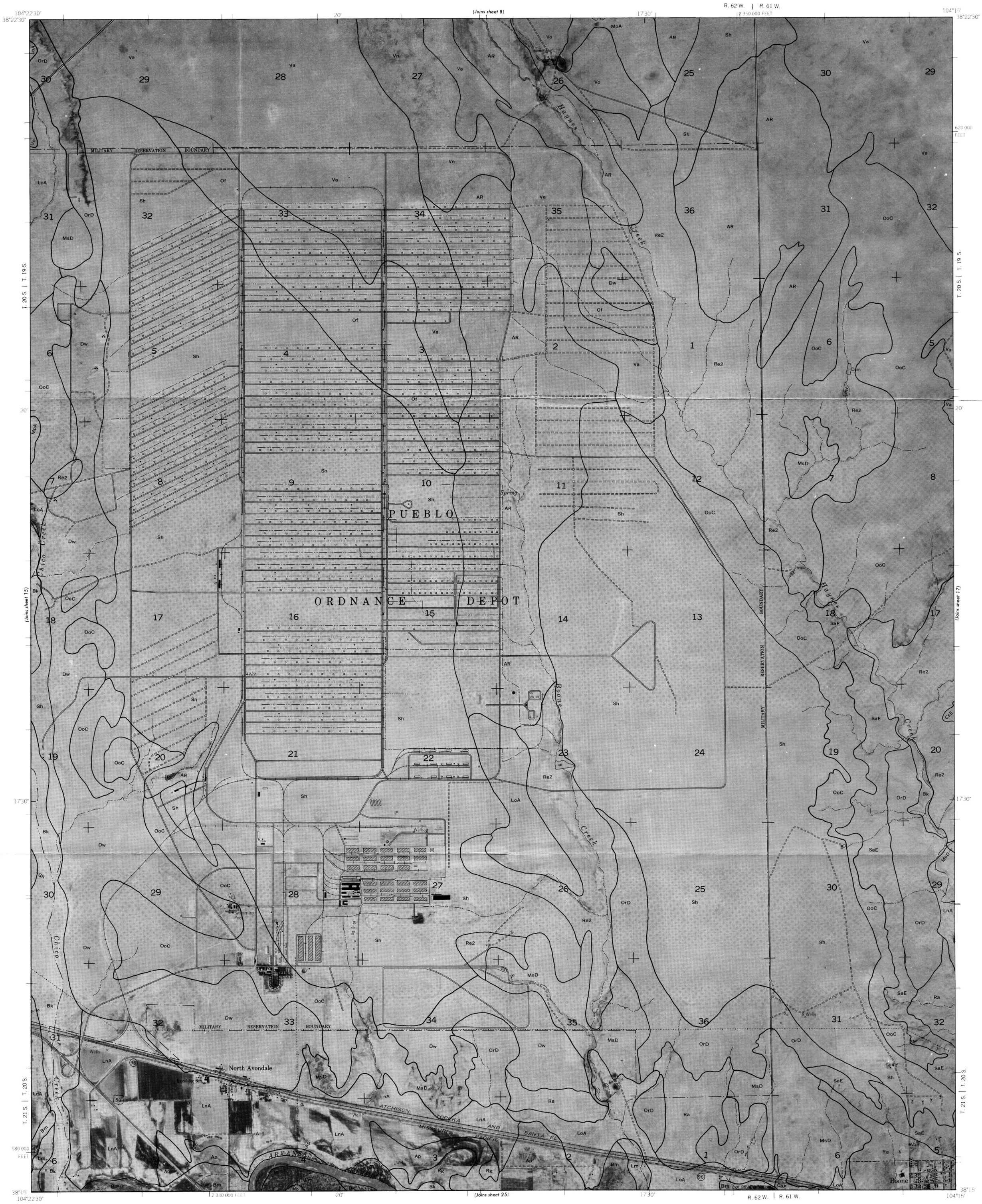

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1 ¾ ½ ¼ 0 1 2 Miles
5000 4000 3000 2000 1000 0 5000 10000 Feet
Scale 1:24000

Orthophotobase compiled from 1974 and 1975 aerial photography by the U.S. Department of The Interior, Geological Survey. Planimetric detail obtained from 7½ minute series maps. 10,000-foot grid based on state coordinate system.

104°15' 12'30" (Joins sheet 9) R. 61 W. | R. 60 W. 10' 2 390 000 FEET 104°07'30"
38°22'30" 38°22'30"

620 000 FEET

T. 20 S. | T. 19 S.

T. 20 S. | T. 19 S.

20'

(Joins sheet 16)

(Joins sheet 18)

17'30"

T. 21 S. | T. 20 S.

T. 21 S. | T. 20 S.

580 000 FEET

38°15' 2 360 000 FEET 12'30" (Joins sheet 26) 10' R. 61 W. | R. 60 W. 104°07'30" 38°15'

Kramer Creek

Spring Creek

Boone Hill

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1 ¾ ½ ¼ 0 1 2 Miles
5000 4000 3000 2000 1000 0 5000 10000 Feet
Scale 1:24000

Orthophotobase compiled from 1974 and 1975 aerial photography by the U.S. Department of The Interior, Geological Survey. Planimetric detail obtained from 7½ minute series maps. 10,000-foot grid based on state coordinate system.

(Joins sheet 10)

104°07'30" 38°22'30" R. 60 W. 5' 2'30" 2 420 000 FEET 104°00' 38°22'30"

620 000 FEET

T. 20 S. | T. 19 S.

(Joins sheet 17)

20'

17'30"

PUEBLO CO
CROWLEY CO

T. 21 S. | T. 20 S.

590 000 FEET

38°15' 104°07'30" 2 400 000 FEET R. 60 W. 5' 2'30" 38°15' 104°00'

(Joins sheet 27)

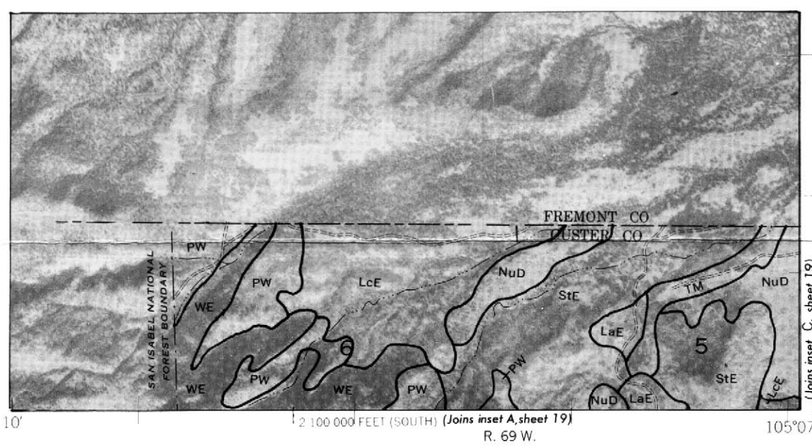
This soil survey was compiled in 1977 by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

¾ ½ ¼ 0 1 2 Miles
5000 4000 3000 2000 1000 0 5000 10 000 Feet
Scale 1:24000

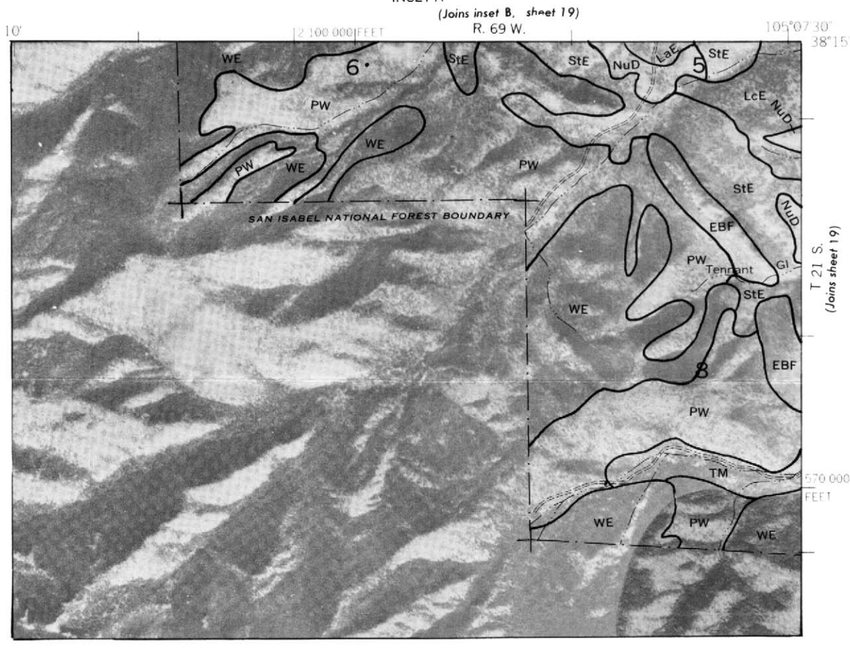
Orthophotobase compiled from 1974 and 1975 aerial photography by the U.S. Department of The Interior, Geological Survey. Planimetric detail obtained from 7½ minute series maps. 10,000 foot grid based on state coordinate system.

(Joins inset A, sheet 19)
(Joins inset C, sheet 19)
(Joins sheet 20)

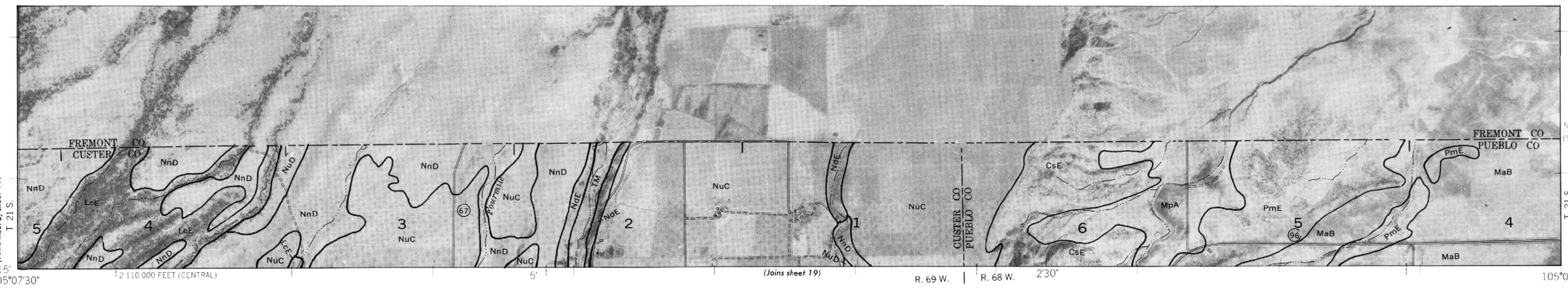
INSET B



INSET A



INSET C



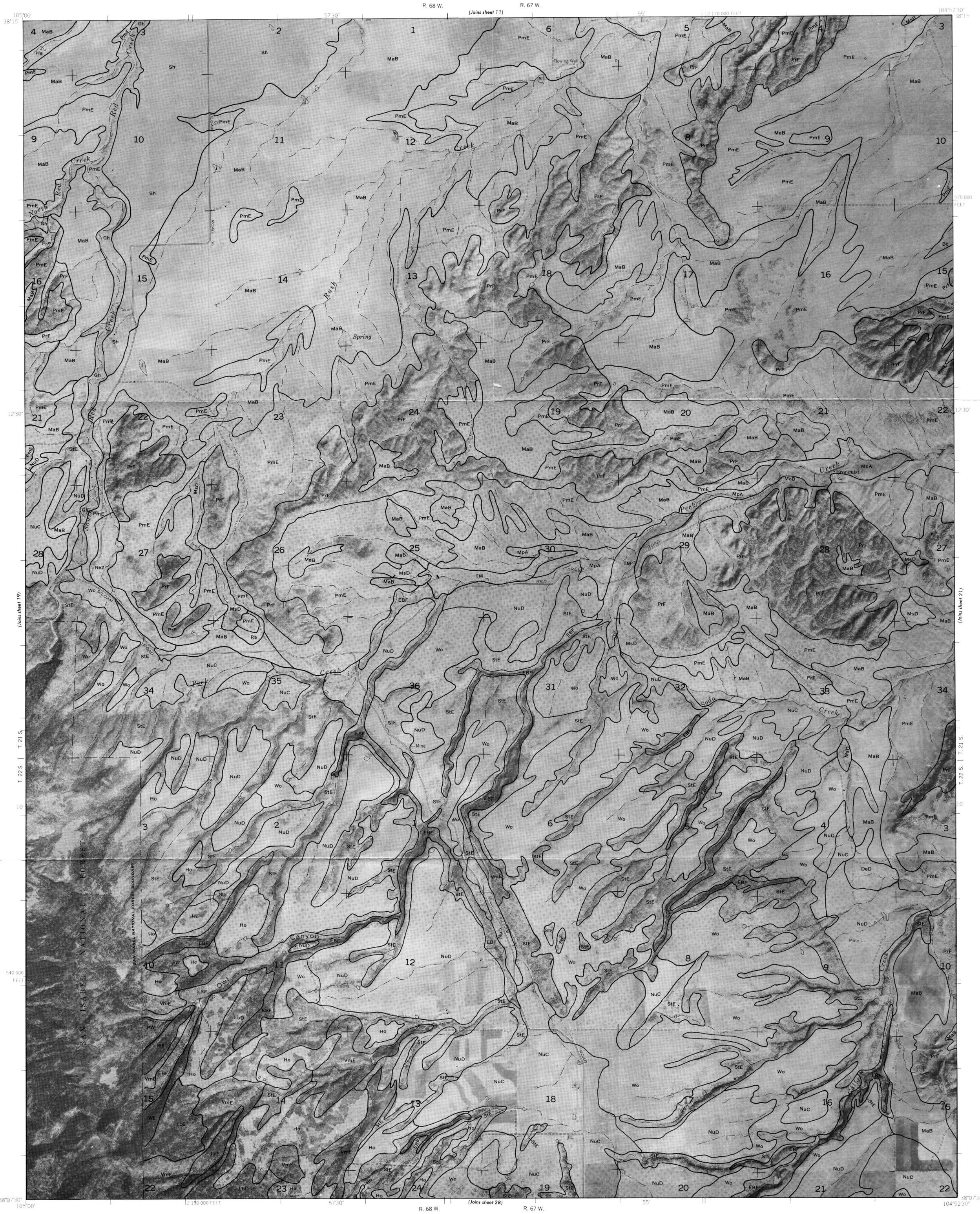
This soil survey was compiled in 1977 by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

Scale 1:24000

Orthophotobase compiled from 1974 and 1975 aerial photography by the U.S. Department of The Interior, Geological Survey.
Planimetric detail obtained from 7½ minute series maps.
10,000-foot grid based on state coordinate system.

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SHEET NO. 20
PUEBLO AREA, COLORADO
PARTS OF PUEBLO AND CUSTER COUNTIES



This soil survey was compiled in 1977 by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

1 ¾ ½ ¼ 0 1 2 Miles
5000 4000 3000 2000 1000 0 5000 10000 Feet
Scale 1:24000

Orthophotobase compiled from 1974 and 1975 aerial photography by the U.S. Department of The Interior, Geological Survey. Planimetric detail obtained from 7½ minute series maps. 10,000-foot grid based on state coordinate system.

PUEBLO AREA, COLORADO, PARTS OF PUEBLO AND CUSTER COUNTIES NO. 20

R. 67 W. | R. 66 W.

(Joins sheet 12)

(Joins sheet 20)

(Joins sheet 22)

T. 22 S. | T. 21 S.

(Joins sheet 29)

R. 67 W | R. 66 W.

This soil survey was compiled in 1977 by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

Scale 1:24000

Orthophotobase compiled from 1974 and 1975 aerial photography by the U.S. Department of The Interior, Geological Survey. Planimetric detail obtained from 7½ minute series maps. 10,000-foot grid based on state coordinate system.

PUEBLO AREA, COLORADO, PARTS OF PUEBLO AND CUSTER COUNTIES NO. 21

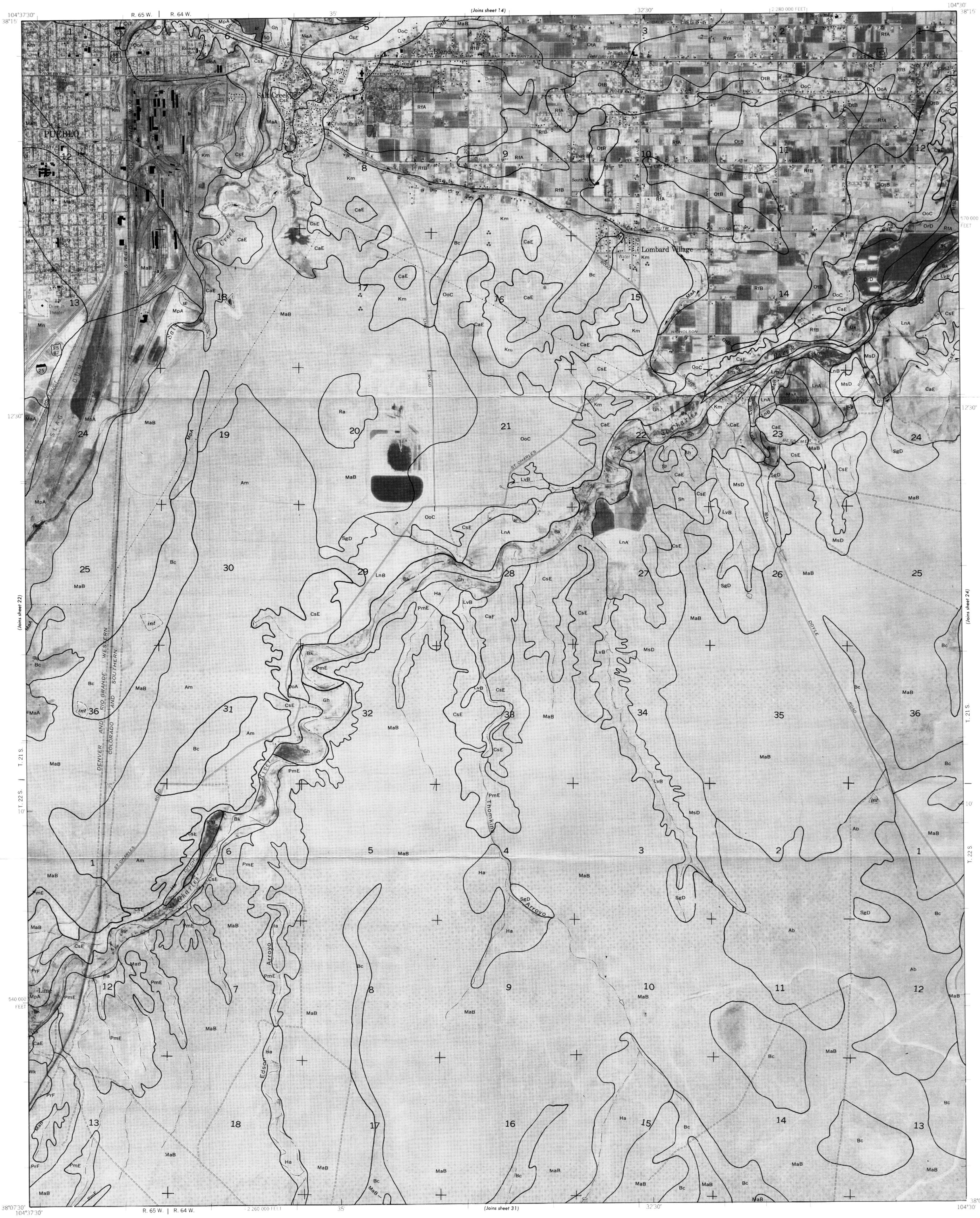
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SHEET NO. 22
PUEBLO AREA, COLORADO
PARTS OF PUEBLO AND CUSTER COUNTIES

This soil survey was compiled in 1977 by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

Scale 1:24000

Orthophotobase compiled from 1974 and 1975 aerial photography by the U.S. Department of The Interior, Geological Survey. Planimetric detail obtained from 7½ minute series maps. 10,000-foot grid based on state coordinate system.



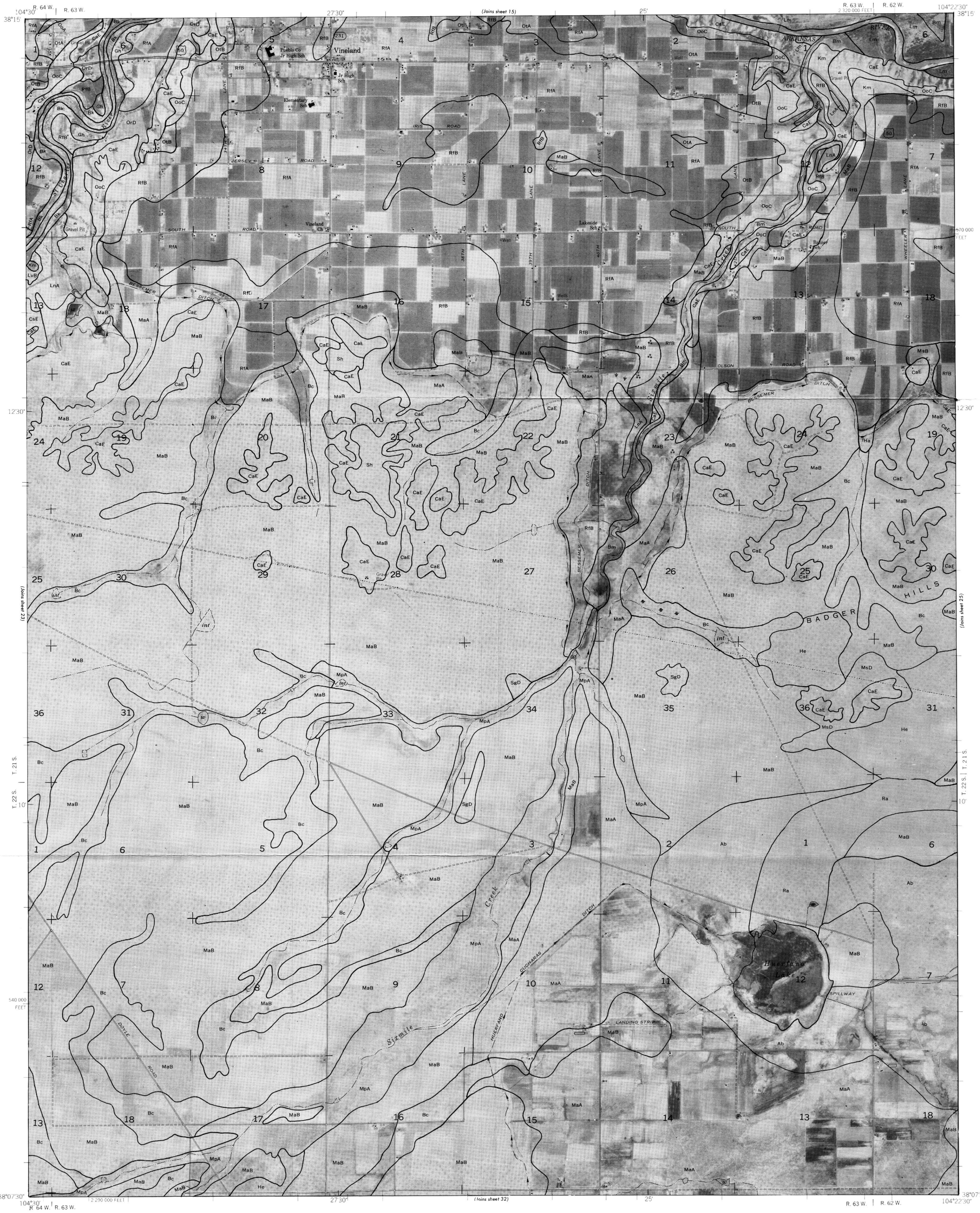
This soil survey was compiled in 1977 by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

Scale 1:24000

Orthophotobase compiled from 1974 and 1975 aerial photography by the U.S. Department of The Interior, Geological Survey. Planimetric detail obtained from 7½ minute series maps. 10,000-foot grid based on state coordinate system.

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SHEET NO. 24
PUEBLO AREA, COLORADO
PARTS OF PUEBLO AND CUSTER COUNTIES



This soil survey was compiled in 1977 by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

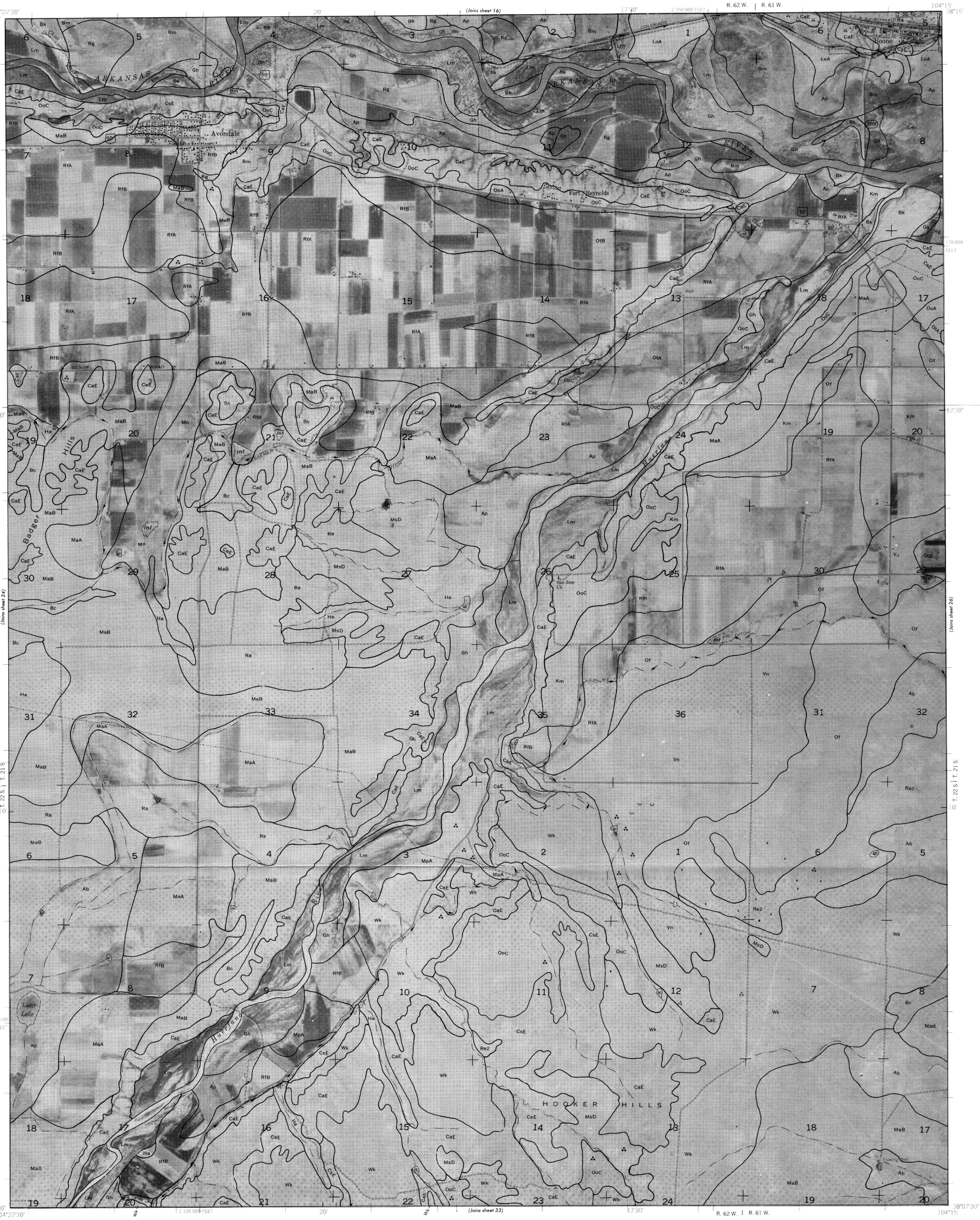
1 ¾ ½ ¼ 0 1 2 Miles
5000 4000 3000 2000 1000 0 5000 10000 Feet
Scale 1:24000

Orthophotobase compiled from 1974 and 1975 aerial photography by the U.S. Department of The Interior, Geological Survey. Planimetric detail obtained from 7½ minute series maps. 10,000-foot grid based on state coordinate system.

PUEBLO AREA, COLORADO, PARTS OF PUEBLO AND CUSTER COUNTIES NO. 24

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SHEET NO. 25
PUEBLO AREA, COLORADO
PARTS OF PUEBLO AND CUSTER COUNTIES



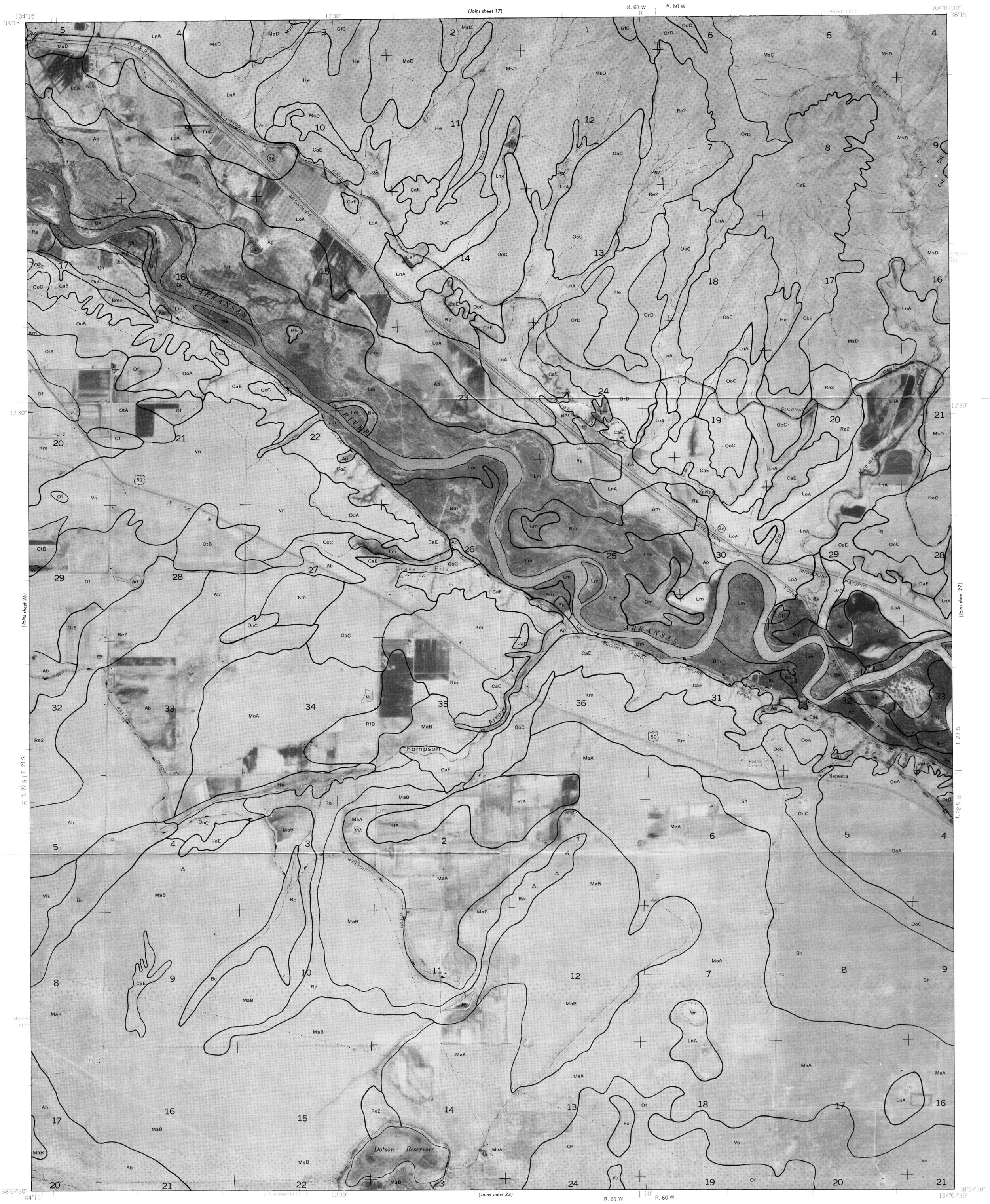
This soil survey was compiled in 1977 by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

Scale 1:24000

Orthophotobase compiled from 1974 and 1975 aerial photography by the U.S. Department of The Interior, Geological Survey. Planimetric detail obtained from 7½ minute series maps. 10,000-foot grid based on state coordinate system.

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SHEET NO. 26
PUEBLO AREA, COLORADO
PARTS OF PUEBLO AND CUSTER COUNTIES



This soil survey was compiled in 1977 by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

1 ¾ ½ ¼ 0 1 2 Miles
5000 4000 3000 2000 1000 0 5000 10000 Feet
Scale 1:24000

Orthophotobase compiled from 1974 and 1975 aerial photography by the U.S. Department of The Interior, Geological Survey. Planimetric detail obtained from 7½ minute series maps. 10 000-foot grid based on state coordinate system.

PUEBLO AREA, COLORADO, PARTS OF PUEBLO AND CUSTER COUNTIES NO. 26

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SHEET NO. 27
PUEBLO AREA, COLORADO
PARTS OF PUEBLO AND CUSTER COUNTIES

(Joins sheet 18)

104°07'30" 38°15' — R. 60 W. — 5' — 2'30" — 104°00' 38°15'

2 430 000 FEET

PUEBLO CO
CROWLEY CO

670 000 FEET

12'30"

(Joins sheet 26)

T. 21 S.
T. 22 S.

10'

540 000 FEET

CROWLEY CO
OTERO CO

38°07'30" 104°07'30" — 2 400 000 FEET — R. 60 W. — 5' — 2'30" — 38°07'30" 104°00'

(Joins sheet 35)

This soil survey was compiled in 1977 by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

Scale 1:24000

Orthophotobase compiled from 1974 and 1975 aerial photography by the U.S. Department of The Interior, Geological Survey. Planimetric detail obtained from 7½ minute series maps. 10,000-foot grid based on state coordinate system.

(Joins sheet 20)
R. 68 W. | R. 67 W.
(Joins sheet 36)
(Joins inset, sheet 10)
(Joins sheet 29)

105°00' 38°07'30" 57'30" 55' 2 170 000 FEET 104°52'30" 38°07'30" 4 230 000 FEET

T. 22 S. T. 23 S. 5'

2'30"

490 000 FEET 2 150 000 FEET 38°00'

SAN ISABEL NATIONAL FOREST BOUNDARY

Wales Canyon · Cialbolt Creek · Middle Creek · North Beulah Hill · St Charles River · Muldoon Canyon · Rock Creek · Burnt Mill Creek · Turtle Buttes · Hogback Mountain · Cedar Grove · Goodpasture · Beulah · Valley View · Sugarloaf Mountain · Mt Signal · Three R Ranch · Ranger Station · Filtration Plant · Stock Arena · Water Tank · Beulah Gem · Well · Spring

This soil survey was compiled in 1977 by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

1 ¾ ½ ¼ 0 1 2 Miles
5000 4000 3000 2000 1000 0 5000 10000 Fee
Scale 1:24000

Orthophotobase compiled from 1974 and 1975 aerial photography by the U.S. Department of The Interior, Geological Survey
Planimetric detail obtained from 7½ minute series maps.
10,000-foot grid based on state coordinate system.

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SHEET NO. 29
PUEBLO AREA COLORADO
PARTS OF PUEBLO AND CUSTER COUNTIES

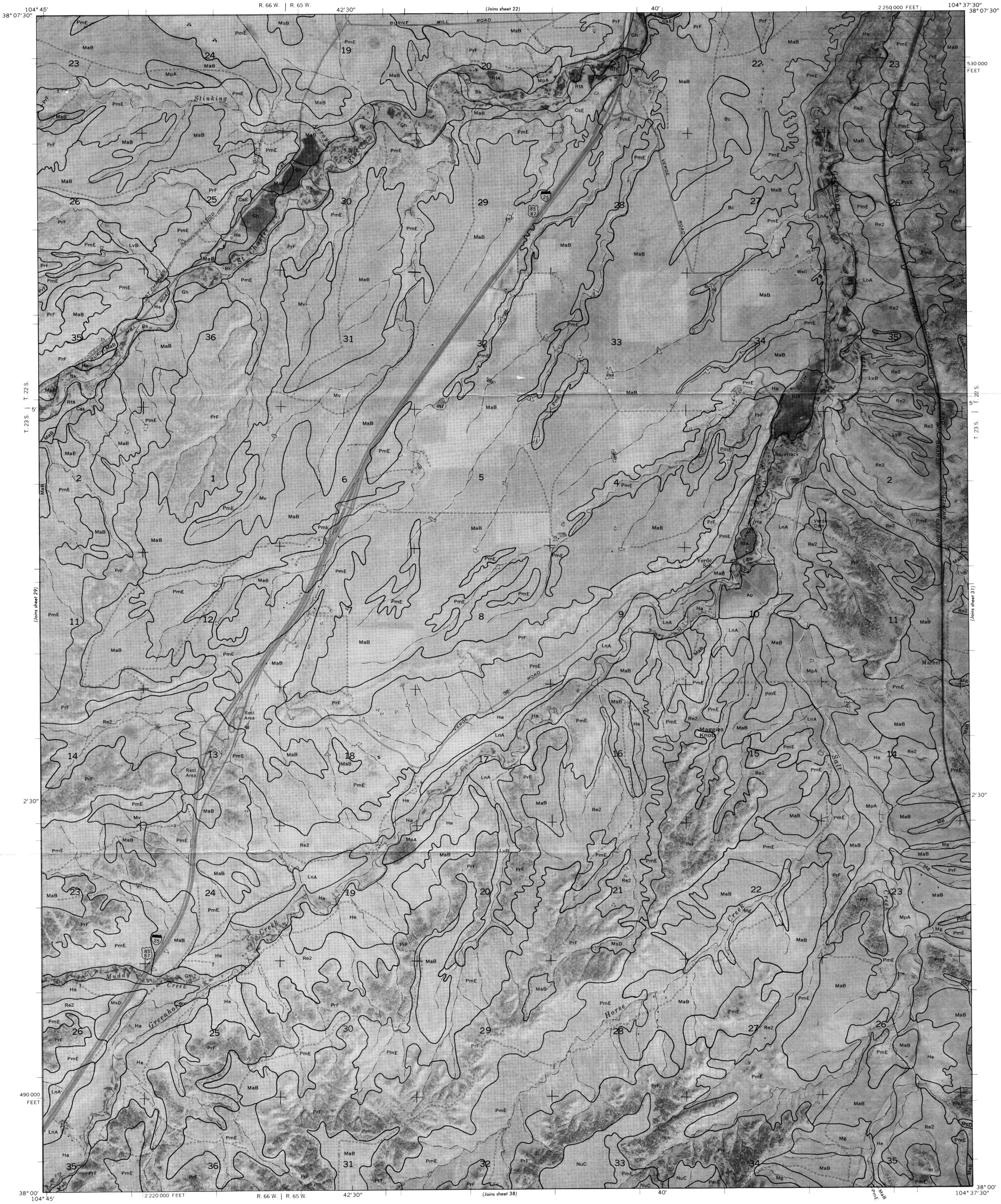
This soil survey was compiled in 1977 by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

1 ¾ ½ ¼ 0 1 2 Miles
5000 4000 3000 2000 1000 0 5000 10000 Feet
Scale 1:24000

Orthophotobase compiled from 1974 and 1975 aerial photography by the U.S. Department of The Interior, Geological Survey. Planimetric detail obtained from 7½ minute series maps. 10,000-foot grid based on state coordinate system.

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SHEET NO. 30
PUEBLO AREA, COLORADO
PARTS OF PUEBLO AND CUSTER COUNTIES



This soil survey was compiled in 1977 by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

Scale 1:24000

Orthophotobase compiled from 1974 and 1975 aerial photography by the U.S. Department of The Interior, Geological Survey. Planimetric detail obtained from 7½ minute series maps. 10,000-foot grid based on state coordinate system.

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SHEET NO. 31
PUEBLO AREA, COLORADO
PARTS OF PUEBLO AND CUSTER COUNTIES

104° 37′ 30″ | R. 65 W. | R. 64 W. | 35′ | (Joins sheet 23) | 32′ 30″ | 2 280 000 FEET | 104° 30′
38° 07′ 30″

530 000 FEET

T. 22 S. | T. 23 S.

(Joins sheet 30) | (Joins sheet 32)

2′ 30″

490 000 FEET

38° 00′
104° 37′ 30″ | R. 65 W. | R. 64 W. | 2 260 000 FEET | 35′ | (Joins sheet 39) | 32′ 30″ | 38° 00′
104° 30′

This soil survey was compiled in 1977 by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

Scale 1:24000

Orthophotobase compiled from 1974 and 1975 aerial photography by the U.S. Department of The Interior, Geological Survey. Planimetric detail obtained from 7½ minute series maps. 10,000-foot grid based on state coordinate system.

PUEBLO AREA, COLORADO. PARTS OF PUEBLO AND CUSTER COUNTIES NO. 31

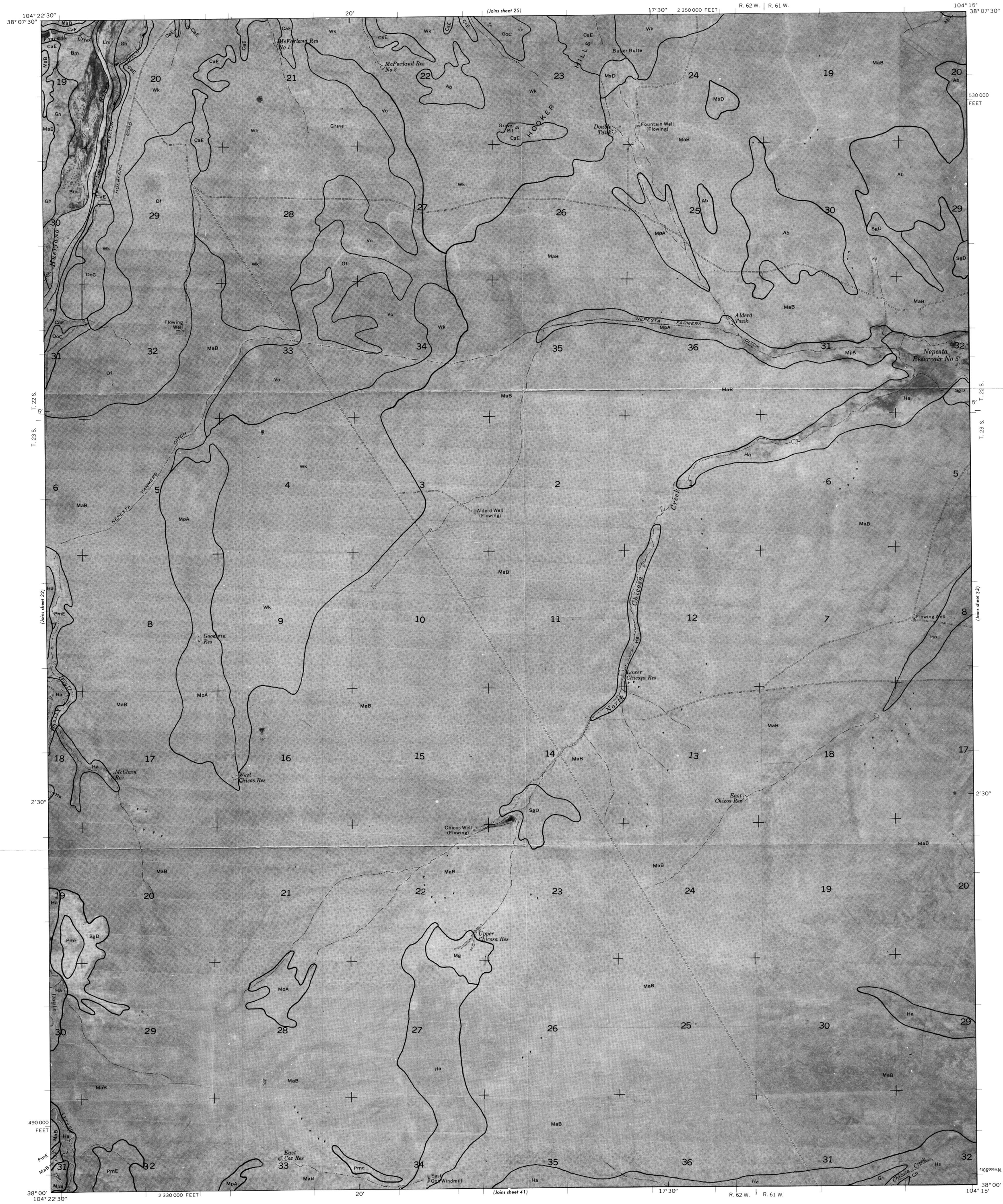
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SHEET NO. 32
PUEBLO AREA, COLORADO
PARTS OF PUEBLO AND CUSTER COUNTIES

This soil survey was compiled in 1977 by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

Scale 1:24000

Orthophotobase compiled from 1974 and 1975 aerial photography by the U.S. Department of The Interior, Geological Survey
Planimetric detail obtained from 7½ minute series maps.
10,000-foot grid based on state coordinate system.



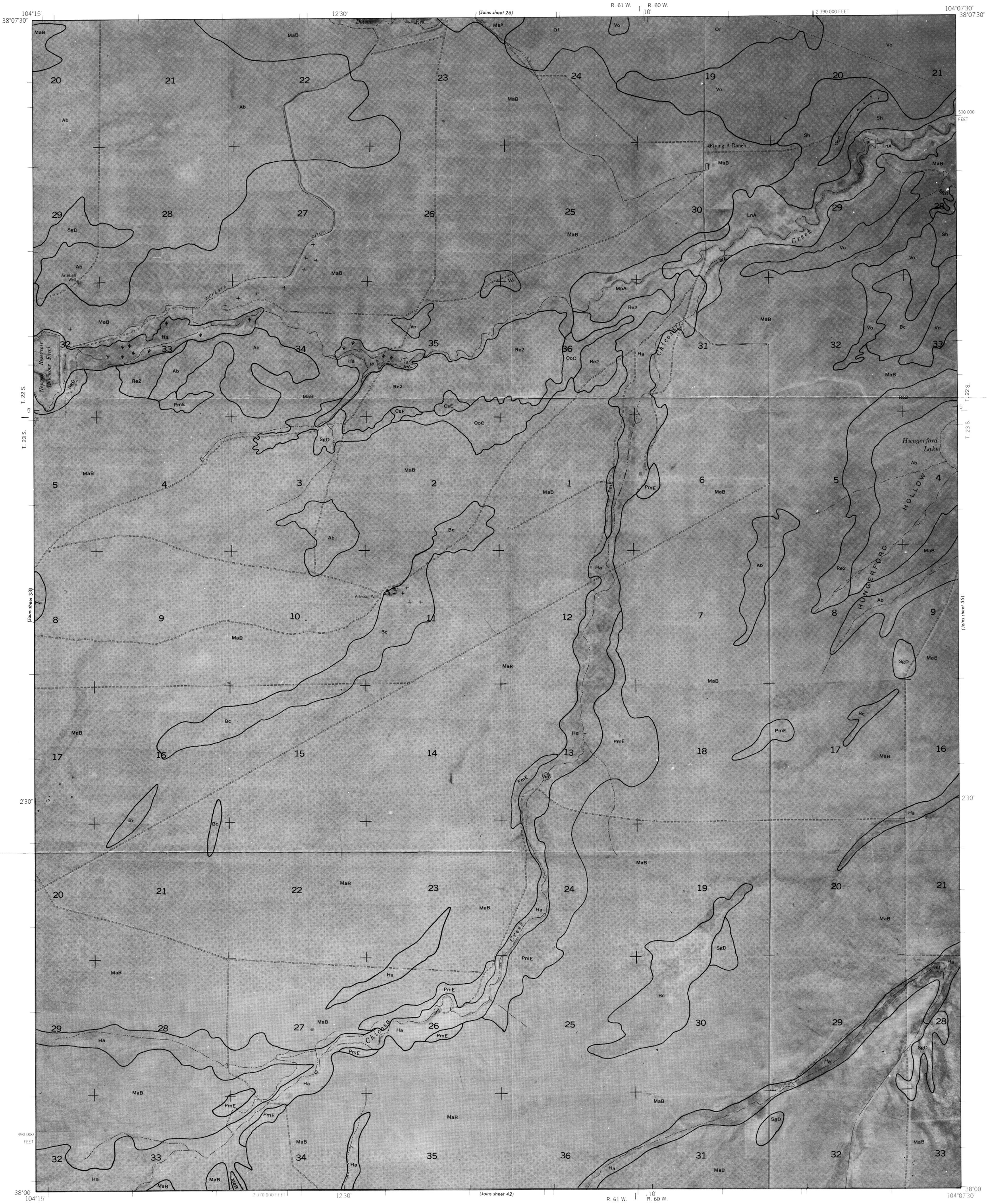
This soil survey was compiled in 1977 by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

Scale 1:24000

Orthophotobase compiled from 1974 and 1975 aerial photography by the U.S. Department of The Interior, Geological Survey. Planimetric detail obtained from 7½ minute series maps. 10,000-foot grid based on state coordinate system.

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SHEET NO. 34
PUEBLO AREA, COLORADO
PARTS OF PUEBLO AND CUSTER COUNTIES



This soil survey was compiled in 1977 by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

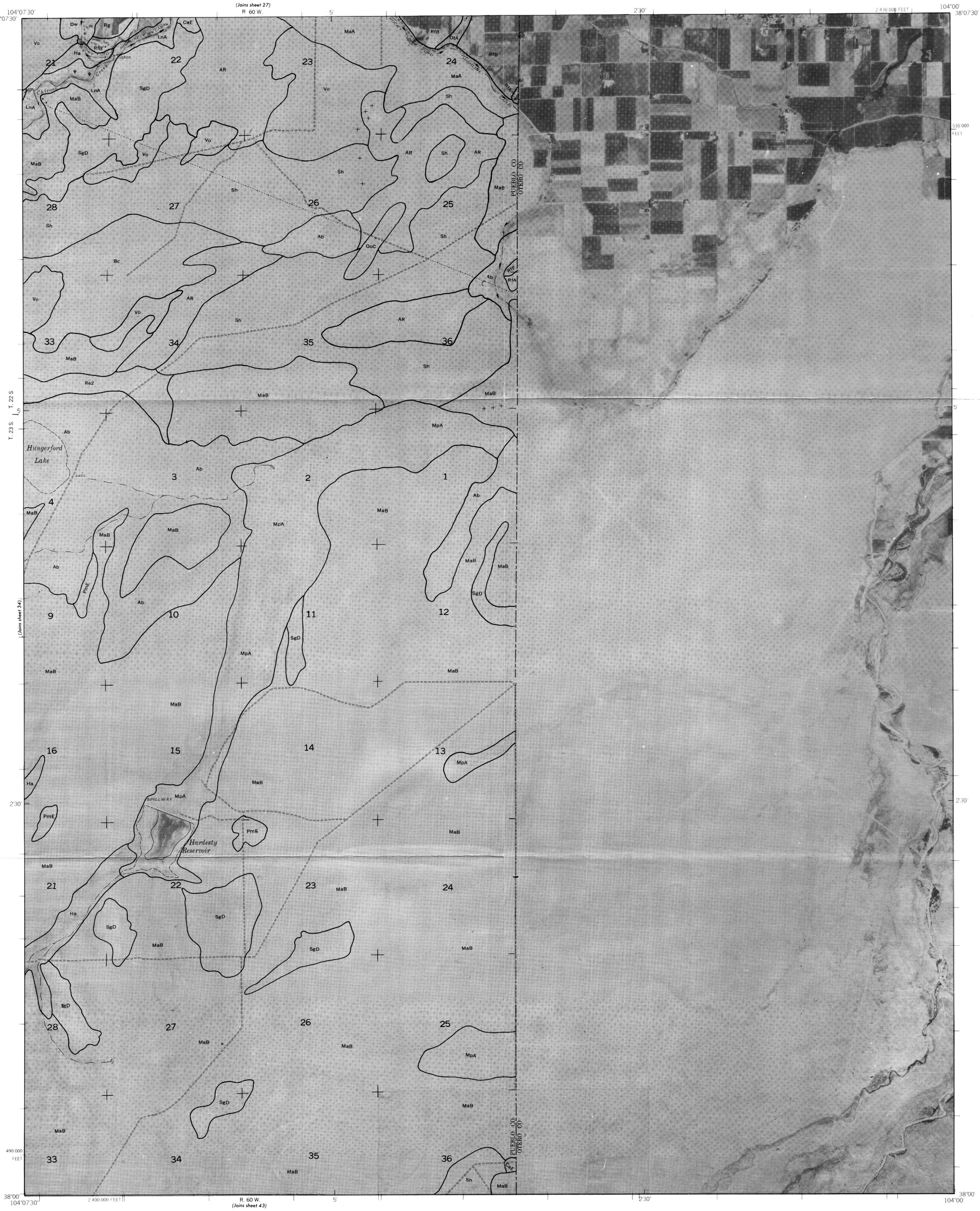
Scale 1:24000

Orthophotobase compiled from 1974 and 1975 aerial photography by the U.S. Department of The Interior, Geological Survey. Planimetric detail obtained from 7½ minute series maps. 10,000-foot grid based on state coordinate system.

PUEBLO AREA, COLORADO, PARTS OF PUEBLO AND CUSTER COUNTIES NO. 34

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SHEET NO. 35
PUEBLO AREA, COLORADO
PARTS OF PUEBLO AND CUSTER COUNTIES



This soil survey was compiled in 1977 by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

1 ¾ ½ ¼ 0 1 2 Miles
5 000 4 000 3 000 2 000 1 000 0 5 000 10 000 Feet
Scale 1:24000

Orthophotobase compiled from 1974 and 1975 aerial photography by the U.S. Department of The Interior, Geological Survey. Planimetric detail obtained from 7½ minute series maps. 10,000-foot grid based on state coordinate system.

(Joins sheet 28)

105° 00' | 57' 30" | R. 68 W. | R. 67 W. | 55' | 2 170 000 FEET | 104° 52' 30" | 38° 00'

T. 24 S. | T. 23 S.

480 000 FEET

450 000 FEET

37° 52' 30" | 2 150 000 FEET

(Joins sheet 37)

T. 25 S. | T. 24 S.

SAN ISABEL NATIONAL FOREST BOUNDARY

PUEBLO CO
HUERFANO CO

Scale 1:24000

This soil survey was compiled in 1977 by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

Orthophotobase compiled from 1974 and 1975 aerial photography by the U.S. Department of The Interior, Geological Survey. Planimetric detail obtained from 7½ minute series maps. 10,000-foot grid based on state coordinate system.

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SHEET NO. 37
PUEBLO AREA, COLORADO
PARTS OF PUEBLO AND CUSTER COUNTIES

104° 52′ 30″ — 38° 00′ — 50′ — R. 67 W. | R. 66 W. — (Joins sheet 29) — 47′ 30″ — 2 210 000 FEET — 104° 45′ — 38° 00′

T. 23 S. | T. 24 S. — 480 000 FEET — 57′ 30″ — T. 24 S. | T. 25 S. — 450 000 FEET — 55′

(Joins sheet 36) — (Joins sheet 38)

37° 52′ 30″ — 104° 52′ 30″ — 2 190 000 FEET — 50′ — R. 67 W. | R. 66 W. — 47′ 30″ — 37° 52′ 30″ — 104° 45′

This soil survey was compiled in 1977 by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

1 — ¾ — ½ — ¼ — 0 — 1 — 2 Miles
5 000 — 4 000 — 3 000 — 2 000 — 1 000 — 0 — 5 000 — 10 000 Feet
Scale 1:24000

Orthophotobase compiled from 1974 and 1975 aerial photography by the U.S. Department of The Interior, Geological Survey. Planimetric detail obtained from 7½ minute series maps. 10,000-foot grid based on state coordinate system.

PUEBLO AREA, COLORADO, PARTS OF PUEBLO AND CUSTER COUNTIES NO. 37

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SHEET NO. 38
PUEBLO AREA, COLORADO
PARTS OF PUEBLO AND CUSTER COUNTIES

104° 45′ | R. 66 W. | R. 65 W. | 42′ 30″ | (Joins sheet 30) | 40′ | 2 250 000 FEET | 104° 37′ 30″
38° 00′ | T. 24 S. | T. 23 S. | 480 000 FEET | 57′ 30″ | (Joins sheet 37) | (Joins sheet 39) | 55′ | T. 25 S. | T. 24 S. | 450 000 FEET
37° 52′ 30″ | 2 220 000 FEET

Willow Spring
Creek
RR Spring
Salt Spring
Lees Spring
Mills
Arroyo
GRANEROS FLATS
CEDARWOOD ROAD
Graneros Sch
Well
Sheep Spring
Apache Creek
ARKANSAS RIVER
PUEBLO CO
HUERFANO CO

This soil survey was compiled in 1977 by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

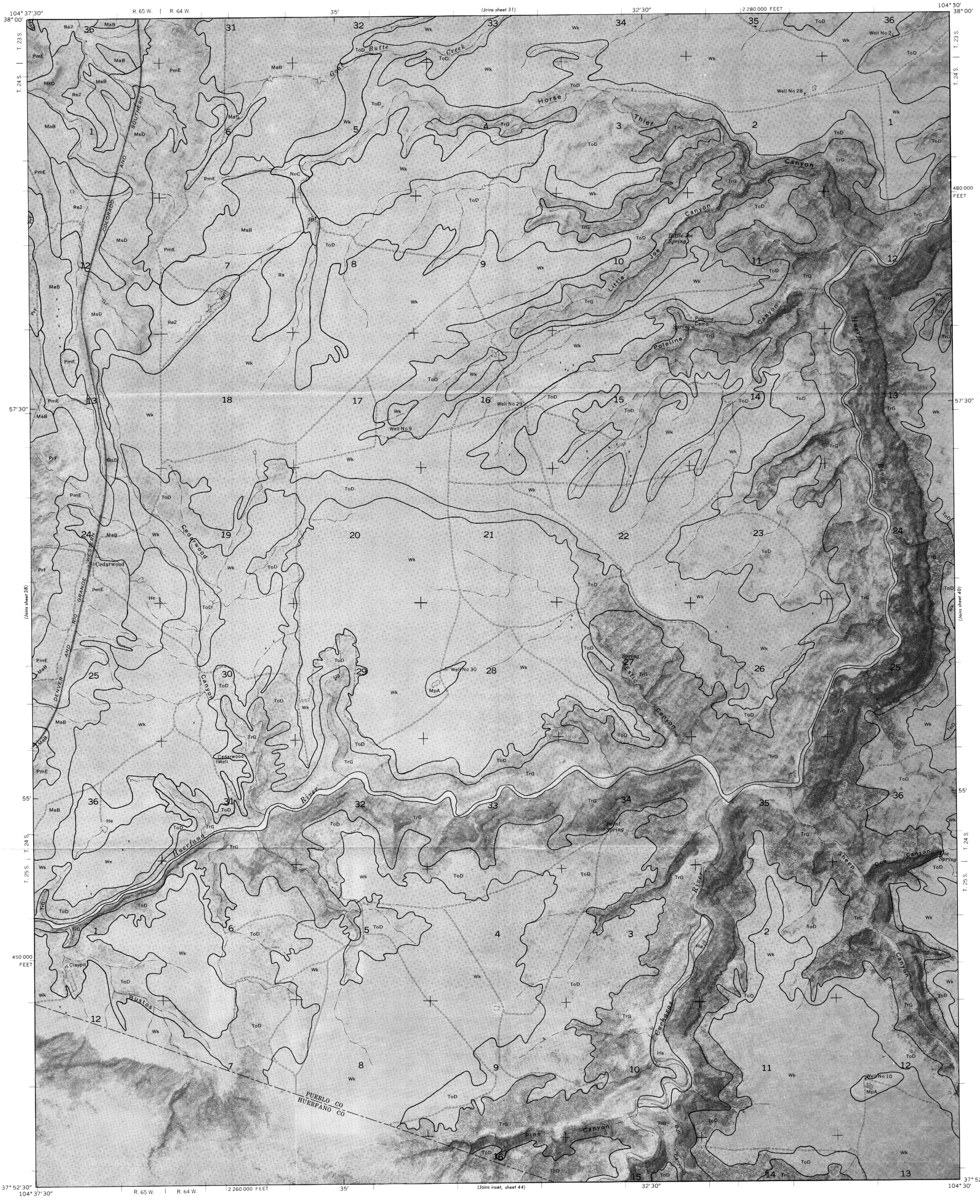
1 ¾ ½ ¼ 0 1 2 Miles
5 000 4 000 3 000 2 000 1 000 0 5 000 10 000 Feet
Scale 1:24000

Orthophotobase compiled from 1974 and 1975 aerial photography by the U.S. Department of The Interior, Geological Survey. Planimetric detail obtained from 7½ minute series maps. 10,000-foot grid based on state coordinate system.

PUEBLO AREA, COLORADO, PARTS OF PUEBLO AND CUSTER COUNTIES NO. 38

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SHEET NO. 39
PUEBLO AREA, COLORADO
PARTS OF PUEBLO AND CUSTER COUNTIES



This soil survey was compiled in 1977 by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies,

Scale 1:24000

Orthophotobase compiled from 1974 and 1975 aerial photography by the U.S. Department of The Interior, Geological Survey. Planimetric detail obtained from 7½ minute series maps. 10,000-foot grid based on state coordinate system.

R. 64 W. | R. 63 W. — 104° 30′ — 38° 00′ — 27′30″ — (Joins sheet 32) — 25′ — R. 63 W. | R. 62 W. — 104° 22′30″ — 38° 00′

T. 23 S. | T. 24 S.

2 320 000 FEET

480 000 FEET

57′30″

(Joins sheet 39)

(Joins sheet 41)

55′

T. 24 S. | T. 25 S.

450 000 FEET

37° 52′30″ — 104° 30′ — 2 290 000 FEET — 27′30″ — (Joins sheet 44) — 25′ — R. 63 W. | R. 62 W. — 37° 52′30″ — 104° 22′30″

R. 64 W. | R. 63 W.

This soil survey was compiled in 1977 by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

Scale 1:24000

Orthophotobase compiled from 1974 and 1975 aerial photography by the U.S. Department of The Interior, Geological Survey. Planimetric detail obtained from 7½ minute series maps. 10,000-foot grid based on state coordinate system.

PUEBLO AREA, COLORADO, PARTS OF PUEBLO AND CUSTER COUNTIES NO. 40

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SHEET NO. 41
PUEBLO AREA, COLORADO
PARTS OF PUEBLO AND CUSTER COUNTIES

This soil survey was compiled in 1977 by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

Scale 1:24000

Orthophotobase compiled from 1974 and 1975 aerial photography by the U.S. Department of The Interior, Geological Survey. Planimetric detail obtained from 7½ minute series maps. 10,000-foot grid based on state coordinate system.

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SHEET NO. 42
PUEBLO AREA, COLORADO
PARTS OF PUEBLO AND CUSTER COUNTIES

This soil survey was compiled in 1977 by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

Scale 1:24000

Orthophotobase compiled from 1974 and 1975 aerial photography by the U.S. Department of The Interior, Geological Survey. Planimetric detail obtained from 7½ minute series maps. 10,000-foot grid based on state coordinate system.

(Joins sheet 35)

104° 07′ 30″ — 38° 00′ — R. 60 W. — 5′ — 2′ 30″ — 2 430 000 FEET — 104° 00′ — 38° 00′

T. 24 S. | T. 23 S.

480 000 FEET

57′ 30″

(Joins sheet 42)

55′

T. 25 S. | T. 24 S.

450 000 FEET

37° 52′ 30″ — 104° 07′ 30″ — 2 400 000 FEET — R. 60 W. — 5′ — 2′ 30″ — 37° 52′ 30″ — 104° 00′

(Joins sheet 47)

PUEBLO CO
OTERO CO

Creek
Mustang
Arroyo
Powell

MaB MpA Ha SgD PmE LoA Sh

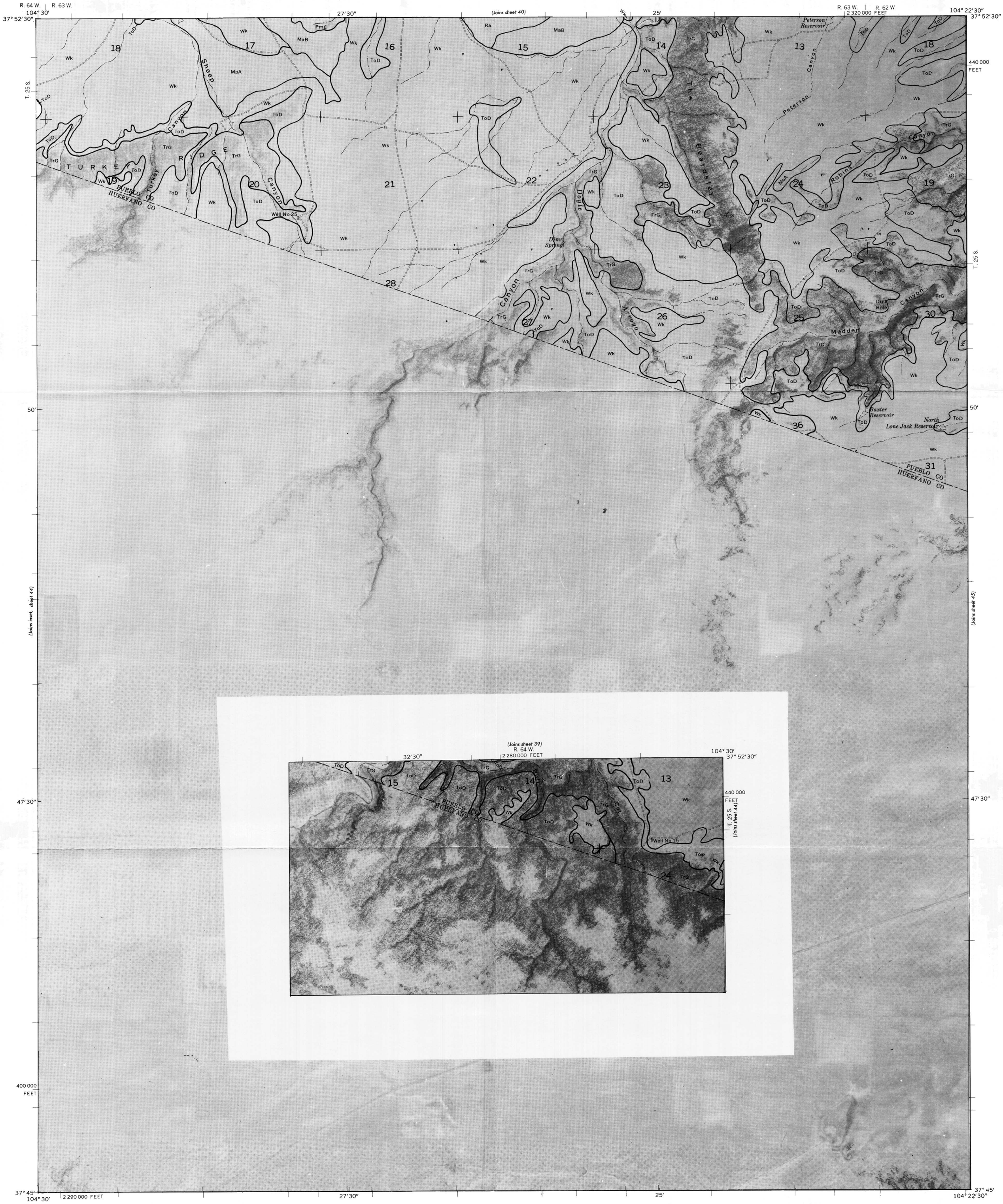
Scale 1:24000

This soil survey was compiled in 1977 by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

Orthophotobase compiled from 1974 and 1975 aerial photography by the U.S. Department of The Interior, Geological Survey. Planimetric detail obtained from 7½ minute series maps. 10,000-foot grid based on state coordinate system.

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SHEET NO. 44
PUEBLO AREA, COLORADO
PARTS OF PUEBLO AND CUSTER COUNTIES



This soil survey was compiled in 1977 by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

1 ¾ ½ ¼ 0 1 2 Miles
5000 4000 3000 2000 1000 0 5000 10000 Feet
Scale 1:24000

Orthophotobase compiled from 1974 and 1975 aerial photography by the U.S. Department of The Interior, Geological Survey. Planimetric detail obtained from 7½ minute series maps. 10,000-foot grid based on state coordinate system.

(Joins sheet 41)
(Joins sheet 44)
(Joins sheet 46)
(Joins sheet 47)

Mayer Res
Spurlock Ranch
Cottonwood Spring
Mustang Canyon
Robins Canyon
Madden Canyon
Prairie Dog Res
Ocenx Spring
Iron Spring
Myers ROAD
El Hondo Spring
Baxter Res
Jack Canyon
Lone Creek
Cable Res
Federal Res
Canyon Res
Whiskey Spring
Log House Res
Plum Creek
Myers Spring
Cedar Crest
Arroyo
Cactus Flat Windmill
Myers Camp
Plum Spring
RED TOP ROAD

PUEBLO CO
HUERFANO CO
LAS ANIMAS CO
OTERO CO

T. 25 S.
T. 26 S.

104°22'30" 37°52'30" — 104°15' 37°52'30"
104°07'30" 37°45' — 2'30" 37°45'
20' 17'30" 5'
R. 62 W. | R. 61 W. | R. 60 W.
2 360 000 FEET
2 330 000 FEET
440 000 FEET
400 000 FEET
50' 47'30"

This soil survey was compiled in 1977 by the U.S. Department of Agriculture Soil Conservation Service and cooperating agencies.

Scale 1:24000

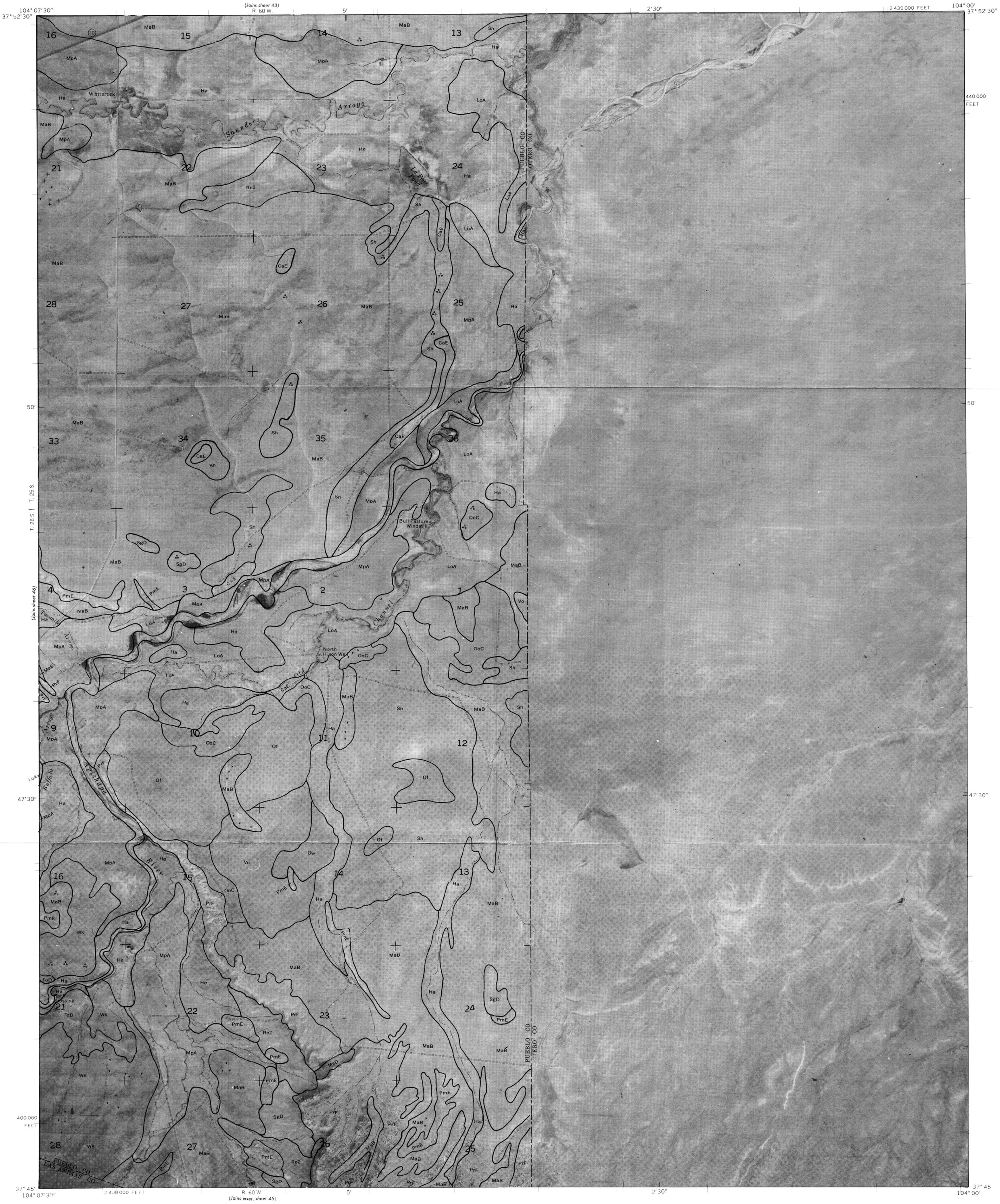
Orthophotobase compiled from 1974 and 1975 aerial photography by the U.S. Department of The Interior, Geological Survey. Planimetric detail obtained from 7½ minute series maps. 10,000-foot grid based on state coordinate system.

This soil survey was compiled in 1977 by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

Scale 1:24000

Orthophotobase compiled from 1974 and 1975 aerial photography by the U.S. Department of The Interior, Geological Survey. Planimetric detail obtained from 7½ minute series maps. 10,000-foot grid based on state coordinate system.

PUEBLO AREA, COLORADO. PARTS OF PUEBLO AND CUSTER COUNTIES NO. 46



This soil survey was compiled in 1977 by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

Scale 1:24000

Orthophotobase compiled from 1954 and 1955 aerial photography by the U.S. Department of The Interior, Geological Survey. Planimetric detail obtained from 7½ minute series maps. 10,000-foot grid based on state coordinate system.